$4.00 per Year. MAY 7, 1908. Price 10 Cents

AMERICAN MACHINIST

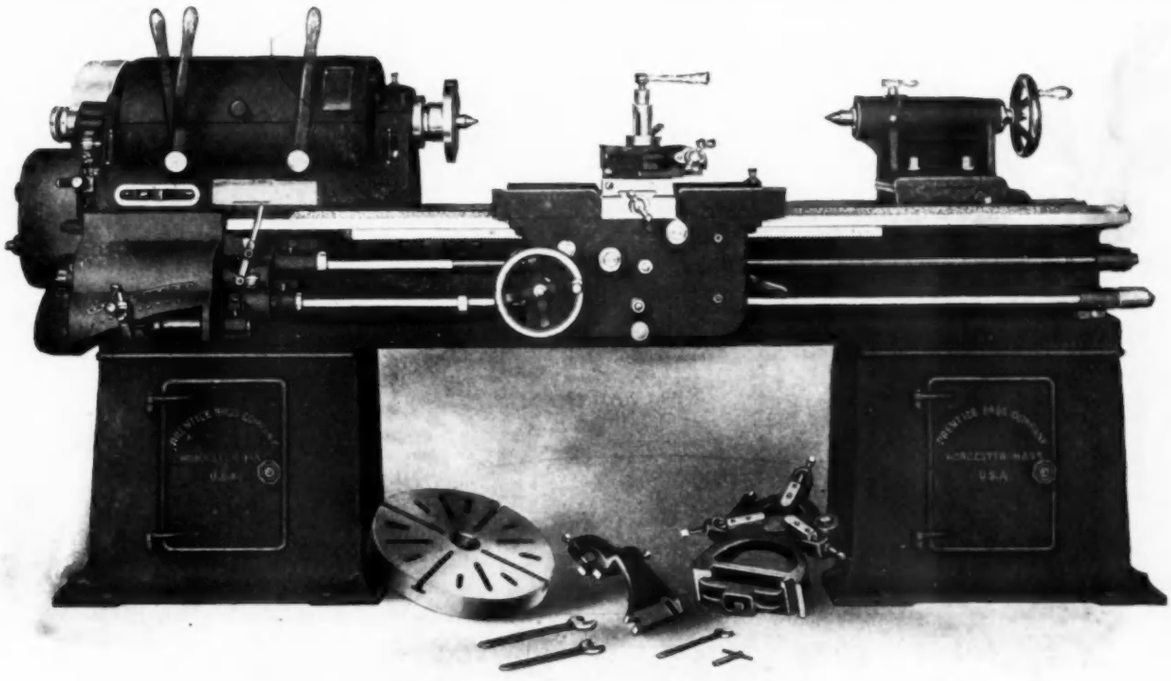
A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY.

Vol. 31. 505 PEARL STREET, NEW YORK. No. 19.

Index to Advertisers and Classified Index Following Reading Matter.

A PRENTICE COST REDUCER



16 Inch Swing High Speed Geared Head Lathe

This Prentice Lathe has many features all its own that give it a remarkable efficiency wherever high speed steel tools are used. It is powerful, strong and so simply operated that an inexperienced hand can run it. If you value fast, accurate Lathe work at minimum expense, investigate this "Prentice."

CIRCULAR?

Prentice Brothers Company,

Builders of Radial and Upright Drilling Machines, Engine and Turret Lathes.

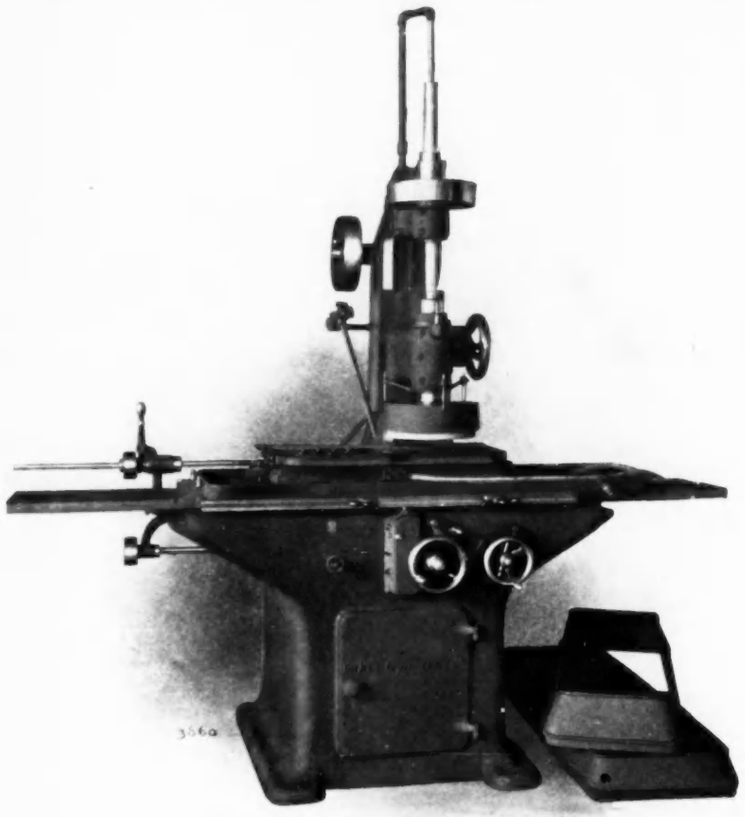
Worcester, Mass., U. S. A.

AGENTS—The Fairbanks Company, New York, Albany, Boston, Philadelphia, Syracuse, Hartford, New Orleans and Buffalo. The Strong, Carlisle & Hammond Co., Cleveland and Detroit. Chas. G. Smith Company, Pittsburg. The O. L. Packard Machinery Company, Chicago and Milwaukee. The Marshall & Huschart Machinery Co., St. Louis. Alfred H. Schutte, Cologne, Paris, Bilbao, Barcelona, Milan, Brussels and Liege. Schuchardt & Schutte, London, Berlin, Stockholm, St. Petersburg, Vienna, Copenhagen and Budapest.

VERTICAL SURFACE GRINDER

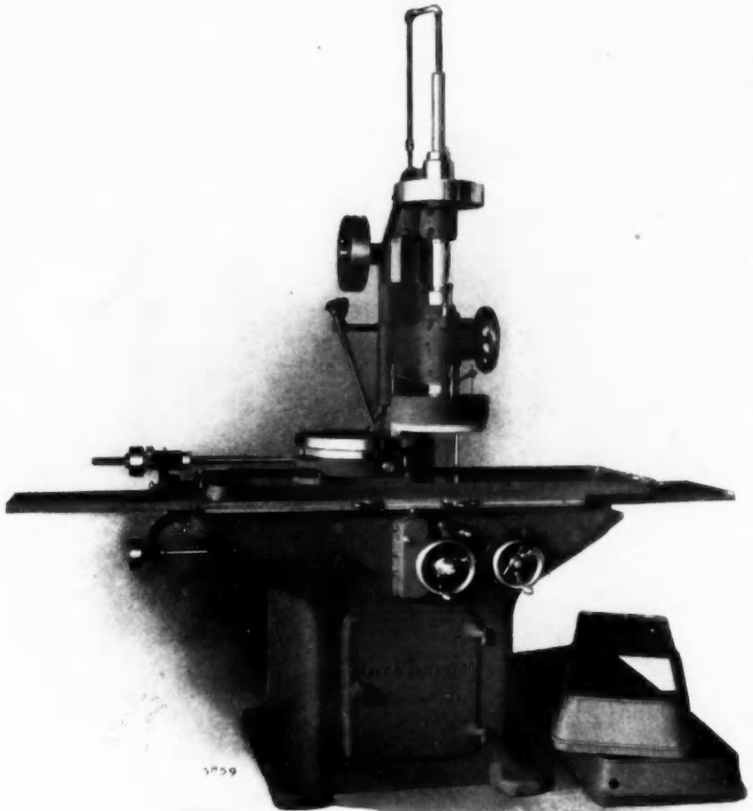
WILL GRIND FROM

12 TO 20 TIMES FASTER THAN ANY SURFACE GRINDER MADE



GRINDING FLAT WORK HELD IN PLACE BY MAGNETIC CHUCK

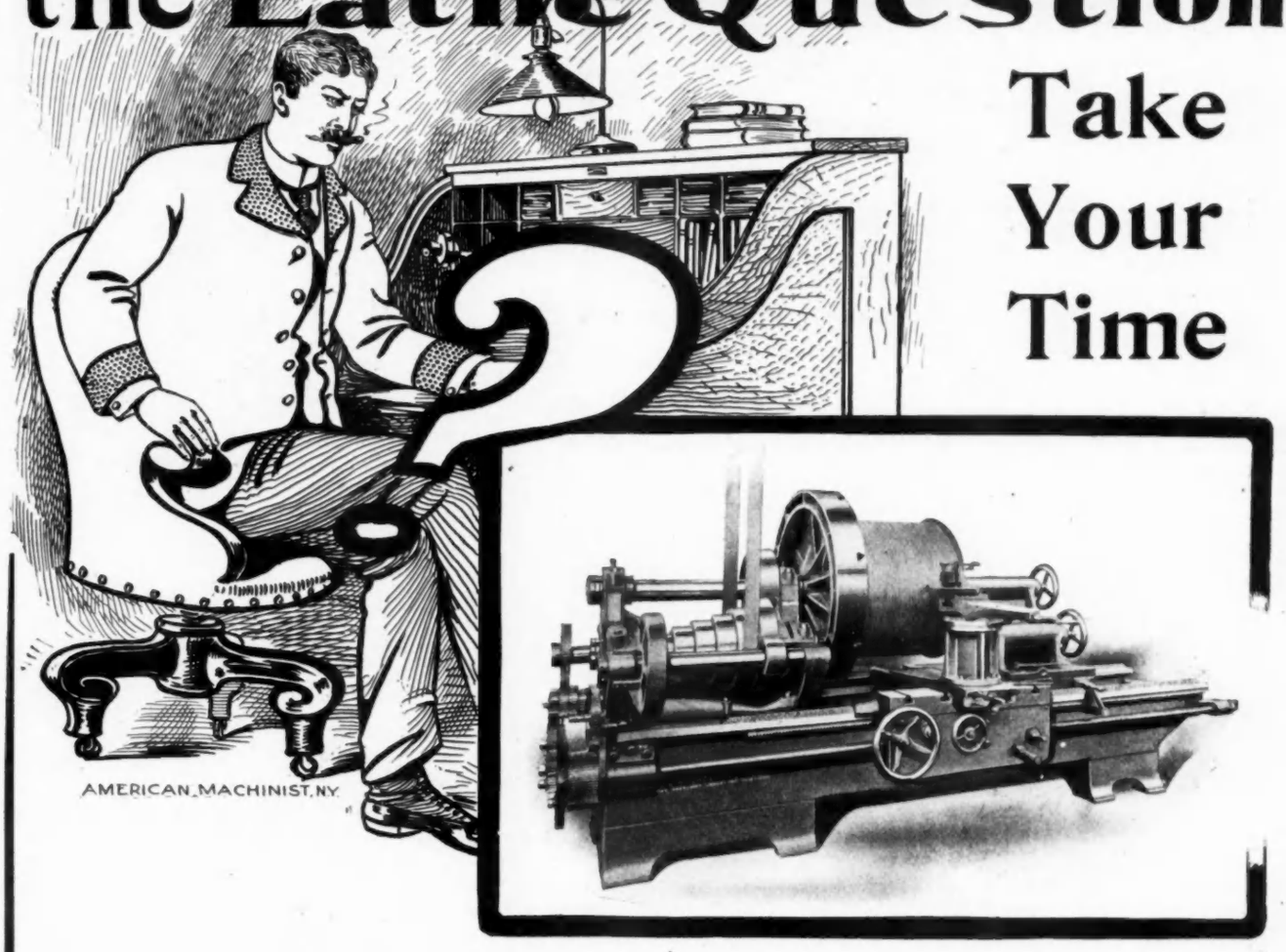
CUP
SHAPE
WHEEL
COVERS
FULL WIDTH
OF WORK
INSURING
PERFECT
FLATNESS
AND
RAPID
REDUCTION



REVOLVING TABLE FOR DISCS, RINGS, COLLARS, ETC., FROM SMALLEST DIAMETER UP TO 16 INCHES

When You Come to Face the Lathe Question

Take Your Time



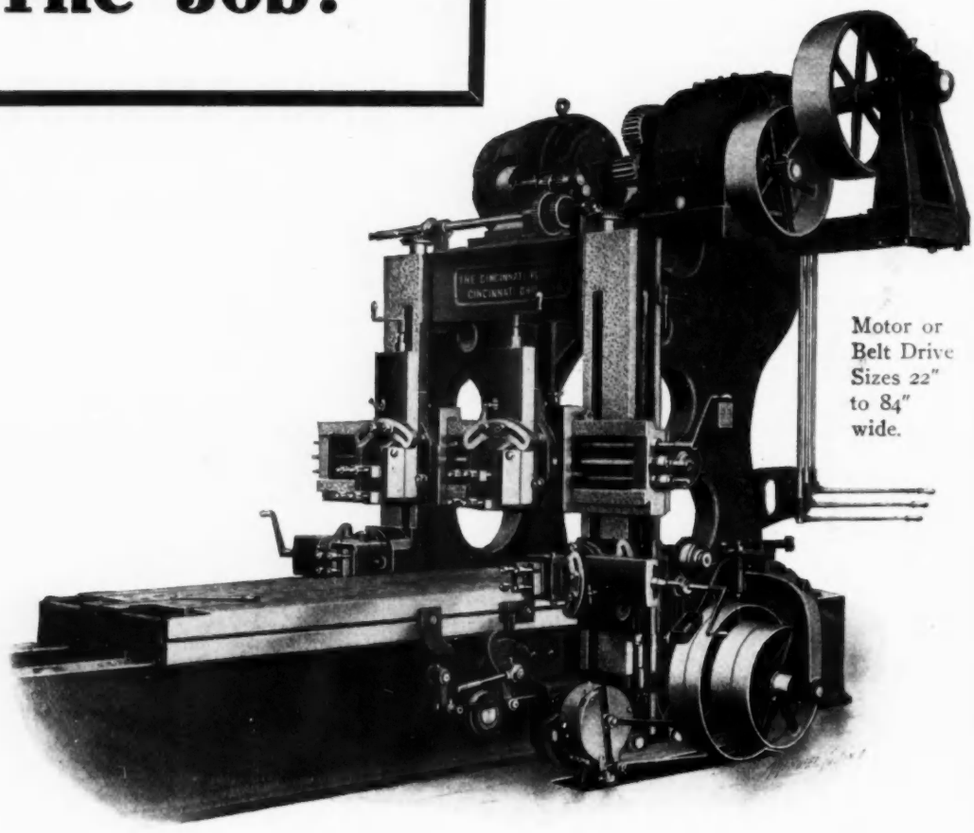
Consider McCabe's "2 in 1" Double Spindle Lathe

and compare it carefully with any other Lathe you may have in mind. 'Tisn't a "gap bed"—'tisn't a "Raised-up"—'tisn't like any other big Lathe, and after the evidence is all in there'll be but one conclusion—that McCabe's "2-in-1" is the Lathe you *need* It's two Lathes in one, a 48" and a 26". It costs about half what you expected to pay for a big 48" single spindle Lathe. The 26" Lathe is thrown in FREE. By shifting from one spindle to the other, you can *always keep it busy*. No waiting 'tween jobs. Think of the time a big Lathe wastes in waiting. That'll clinch the matter! Catalog?

J. J. McCabe, Hudson Terminal, No. 30 Church Street, New York City.

R. A. Hervey, Sidney, N. S. W., Sole Agent for Australasia. F. W. Horne, Yokohama, Japan.

Change The Speed To Suit The Job!



Motor or Belt Drive Sizes 22" to 84" wide.

THE CINCINNATI VARIABLE SPEED PLANER has 4 changes of speed, from 15 to 60 feet a minute, instantly obtainable. Thus the proper speed for roughing or finishing any material is always to be had. Remember, Variable Speed, and NOT return of table, is the all important planer feature. CATALOG?

The Cincinnati Planer Company,

Cincinnati, Ohio, U. S. A.

DOMESTIC AGENTS—Prentiss Tool and Supply Co., New York, Boston, Buffalo and Syracuse. Marshall & Huschart Machinery Co., Chicago. Motch & Merryweather Machinery Co., Cleveland and Detroit. W. E. Shipley Machinery Co., Philadelphia, Pa. Baird Machinery Co., Pittsburg, Pa. W. R. Colcord Machinery Co., St. Louis, Mo. Scott Supply and Tool Co., Denver, Colo. Harron, Rickard & McCone, San Francisco and Los Angeles, Cal. Hallidie Machinery Co., Seattle. Cotton States Belting & Supply Co., Atlanta. The Fairbanks Co., Baltimore. Vonnegut Hardware Co., Indianapolis. Robinson & Carey Co., St. Paul. Zimmerman, Wells & Brown, Portland, Ore.

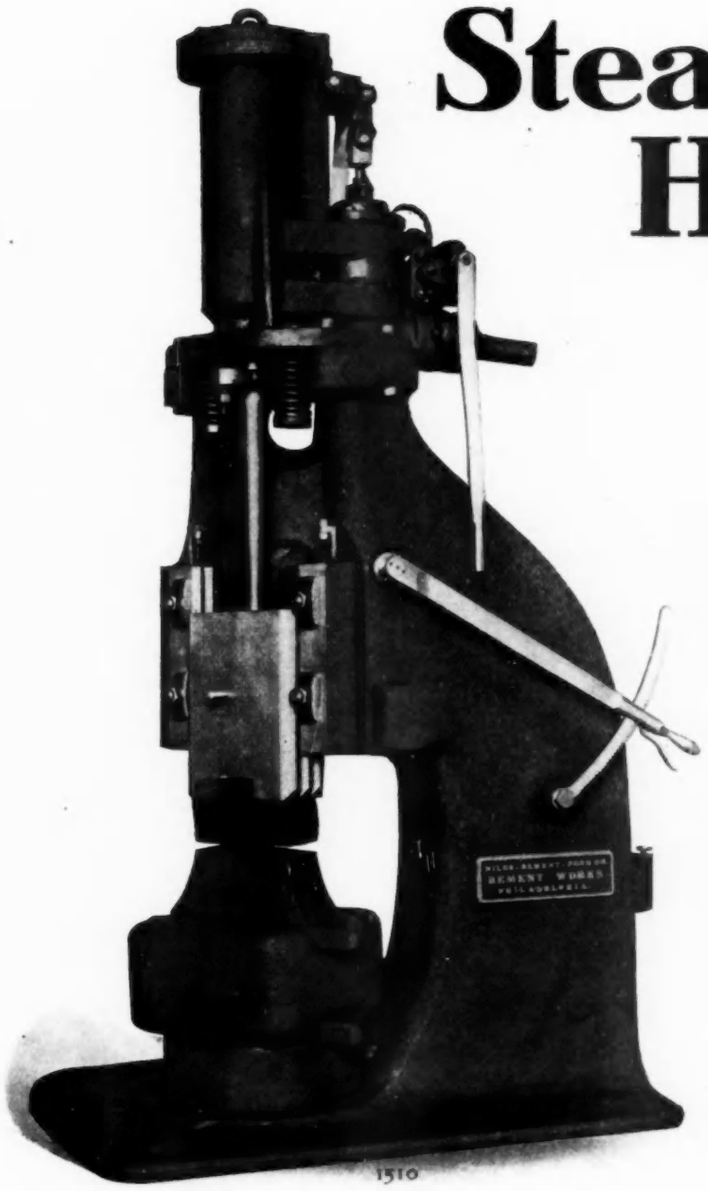
FOREIGN AGENTS—Ludw. Loewe & Co., Berlin, Germany. Vaghi, Accornero & Co., Milan, Italy. R. S. Stokvis & Zonen, Rotterdam, Holland. J. Lambercier & Co., Geneva, Switzerland. A. Englemann & Co., Liege, Belgium. H. W. Petrie, Ltd., Toronto, Montreal and Vancouver.

BEMENT

SLOTTERS
Crank and Geared Types

SHAPERS
Single and Double Head

Steam Hammers



800-Pound Single-Framed Hammer

Single and Double Frame.

Single and Double Open Frame.

Board and Steam Drop.

Steel Tilting.

Bement Hammers take steam above and below piston. Piston type valve, simple and substantial, has few moving pieces requiring little adjustment. All parts regularly manufactured in stock sizes and are interchangeable.

NILES-BEMENT-POND COMPANY,

TRINITY BUILDING, 111 BROADWAY, NEW YORK.

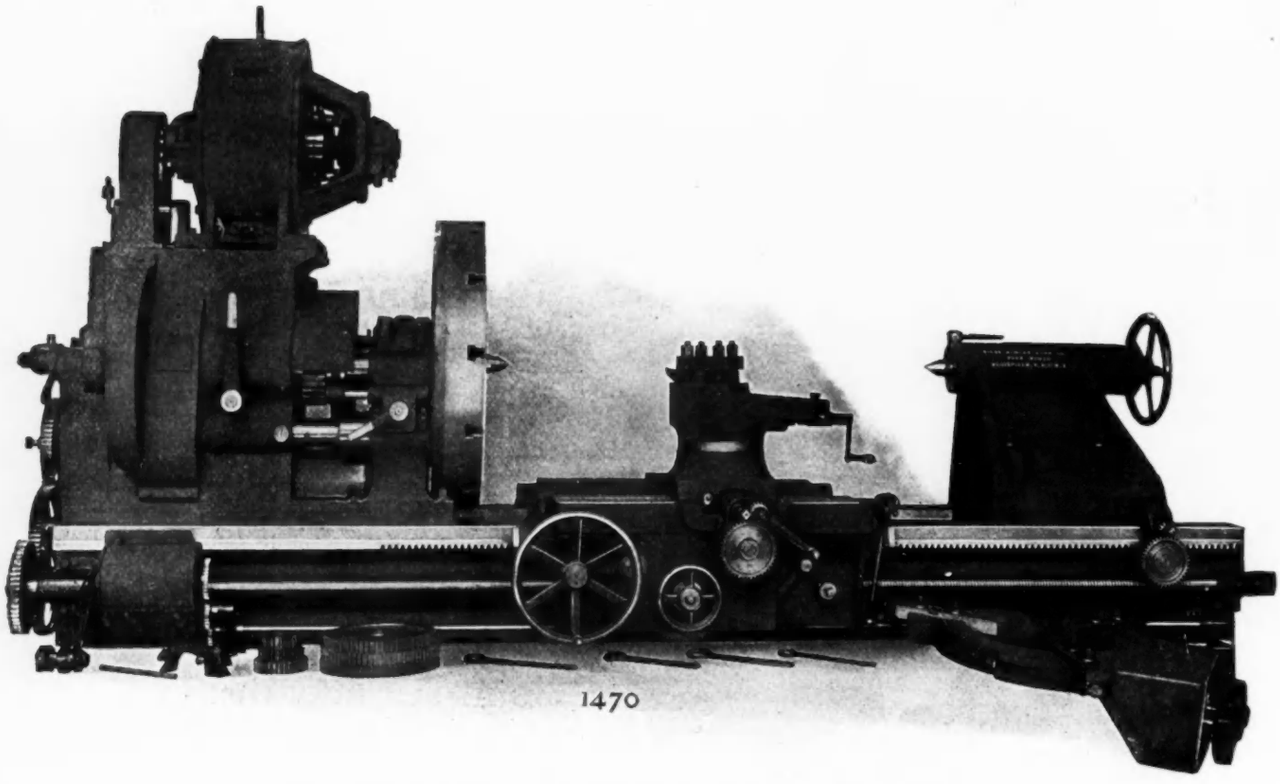
OFFICES:

Boston: Oliver Bldg. Chicago: Commercial National Bank Bldg. Pittsburg: Frick Bldg. St. Louis: 516 North 3d St. Philadelphia: 21st and Callowhill Sts. Birmingham, Ala: Brown-Marx Bldg. Agents: The Canadian Fairbanks Co., Ltd., Montreal, Toronto, Winnipeg and Vancouver. Agents for California, Nevada and Arizona: Harron, Rickard & McCone, 436 Market St., San Francisco, Cal., and 164-8 North Los Angeles St., Los Angeles, Cal. F. W. Horne, 70 C Yokohama, Japan.

POND
HEAVY LATHES

We manufacture lathes of all kinds and sizes, for all classes of work, including:

Bench Lathes	Pulley Lathes	Car Wheel Lathes
Toolmakers' Lathes	Forge Lathes	Driving Wheel Lathes
Engine Lathes	Gun Lathes	Axle Lathes
Turret Lathes	Projectile Lathes	Crank Shaft Lathes
Ingot Lathes	Facing Lathes	Cylinder Lathes, etc.



48-inch Pond Engine Lathe. Motor Driven.

Pond Lathes are so designed as to give ample power and stiffness to allow for heaviest cuts with high-power-steel tools. Full belt power is available at all speeds. Lathes can be readily changed from belt to motor drive or vice-versa.

Further information and illustrated circulars furnished upon request.

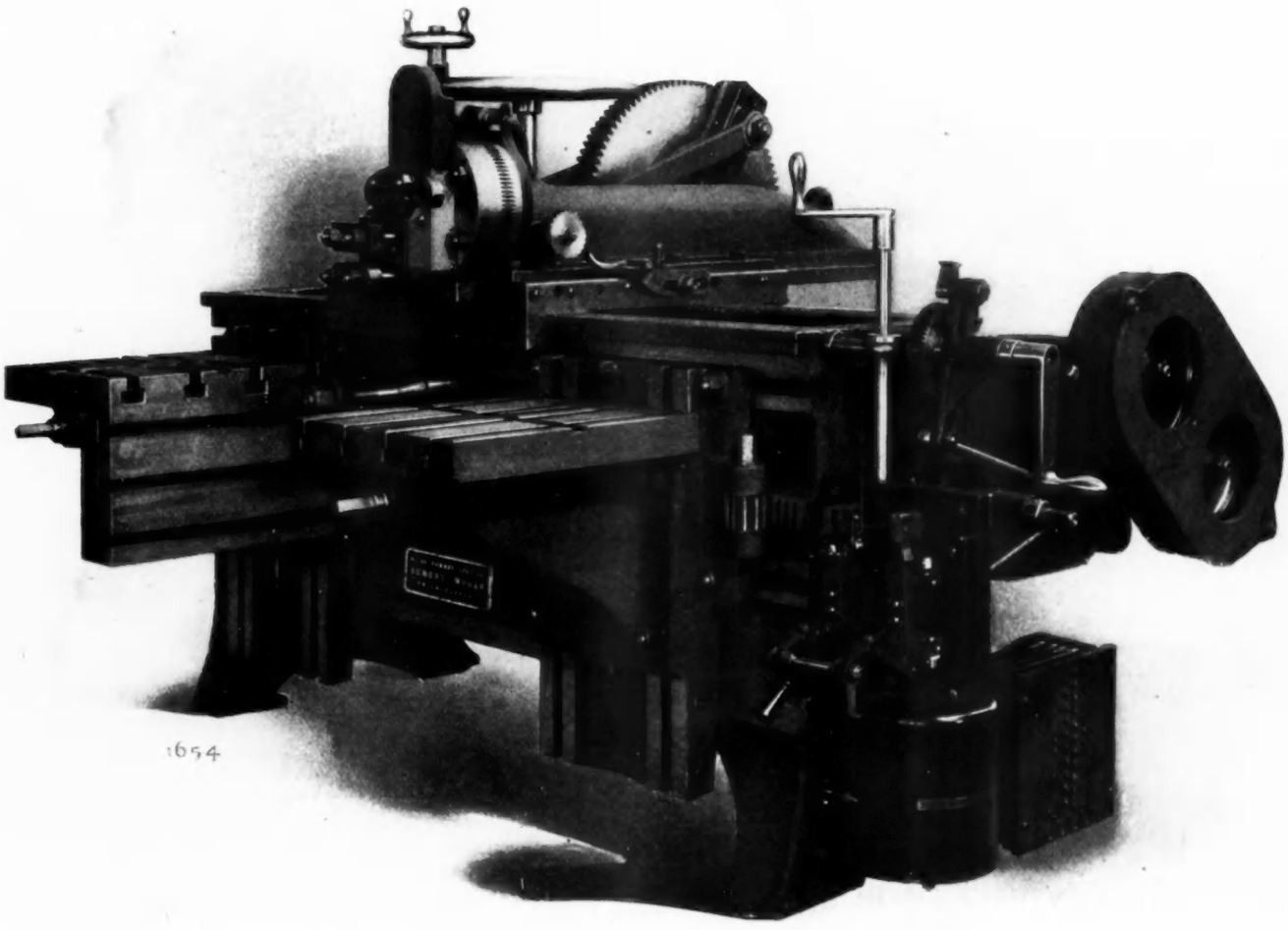
NILES-BEMENT-POND CO.,

TRINITY BUILDING, 111 BROADWAY, NEW YORK, U. S. A.

OFFICES:

Boston: Oliver Bldg. Chicago: Commercial National Bank Bldg. Pittsburg: Frick Bldg. St. Louis: 516 North 3d St. Philadelphia: 21st and Callowhill Sts. Birmingham, Ala: Brown-Marx Bldg. Agents: The Canadian Fairbanks Co., Ltd., Montreal, Toronto, Winnipeg and Vancouver. Agents for California, Nevada and Arizona: Harron, Rickard & McCone, 436 Market St., San Francisco, Cal., and 164-8 North Los Angeles St., Los Angeles, Cal. F. W. Horne. 70 C Yokohama, Japan.

TRAVELING HEAD SHAPERS



20-inch Single Traveling Head Shaping Machine.

Maximum stroke, 20 inches. Vertical travel of tool slide, 8 inches. With a 6-foot, 6-inch bed, the saddle has a traverse of 60 inches. In shops where much heavy work is done, the traveling head shaper is an extremely useful tool. It may be provided with various attachments, including index centers, vise and cone arbor. Belt or Motor Drive.

Bement Shapers are built in several sizes and are readily converted from belt to motor drive after machine is installed.

Illustrated Circular on Request.

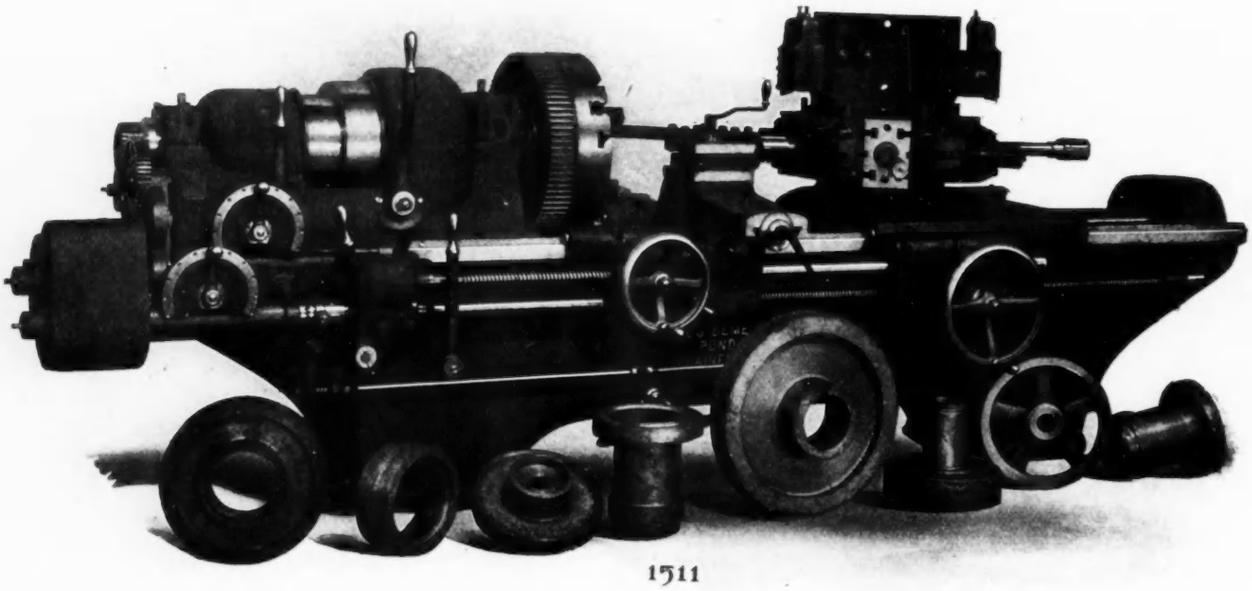
NILES-BEMENT-POND COMPANY,

Trinity Building, 111 Broadway, New York, U. S. A.

OFFICES:

Boston: Oliver Bldg. Chicago: Commercial National Bank Bldg. Pittsburg: Frick Bldg. St. Louis: 516 North 3d St. Philadelphia: 21st and Callowhill Sts. Birmingham, Ala: Brown-Marx Bldg. Agents: The Canadian Fairbanks Co., Ltd., Montreal, Toronto, Winnipeg and Vancouver. Agents for California, Nevada and Arizona: Harron, Rickard & McCone, 436 Market St, San Francisco, Cal., and 164-8 North Los Angeles St, Los Angeles, Cal. F. W. Horne, 70 C Yokohama, Japan.

POND RIGID TURRET LATHE



1511

28-Inch Pond Rigid Turret Lathe With Tool Equipment

Have you a little spare time? If so, wouldn't it pay to look into your chucking work? We can save you 40 to 70 per cent. over engine lathe methods and we should be glad to send a man to look over your work and tell you exactly what saving we can guarantee. It will place you under no obligation to us.

Catalog and full information on request.

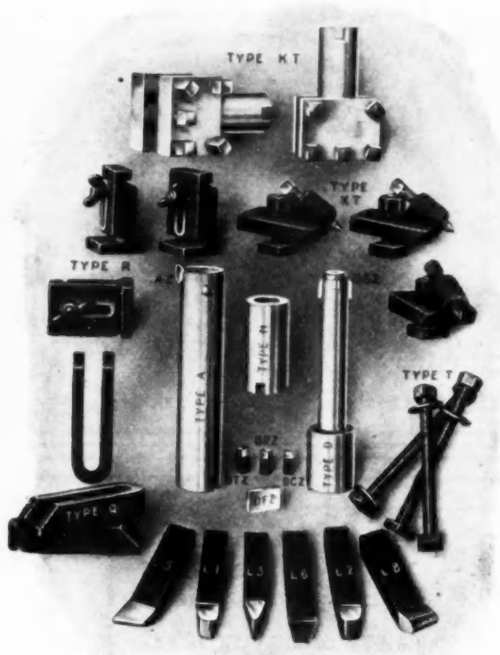
NILES-BEMENT-POND COMPANY

Trinity Building, 111 Broadway, New York, U. S. A.

OFFICES:

Boston: Oliver Bldg. Chicago: Commercial National Bank Bldg. Pittsburg: Frick Bldg. St. Louis: 516 North 3d St. Philadelphia: 21st and Callowhill Sts. Birmingham, Ala: Brown-Marx Bldg. Agents: The Canadian Fairbanks Co., Ltd., Montreal, Toronto, Winnipeg and Vancouver. Agents for California, Nevada and Arizona: Harron, Rickard & McCone, 436 Market St., San Francisco, Cal., and 164-8 North Los Angeles St., Los Angeles, Cal. F. W. Horne, 70 C Yokohama, Japan.

Your Boring Mill cannot do good work rapidly unless it has the proper tool equipment. Either the quality of the work is sacrificed, or the quantity is less than you have a right to expect—because



It's the Tools that Govern Your Boring Mill's Output!

Our new Tool Equipments for Boring Mills are the results of exhaustive experience in that one line. They make a mill do its best work at the fastest possible rate. Our new catalog AE-14 describes these tools. Send for a copy at once.

The Bullard Machine Tool Co. BRIDGEPORT, CONN., U.S.A.

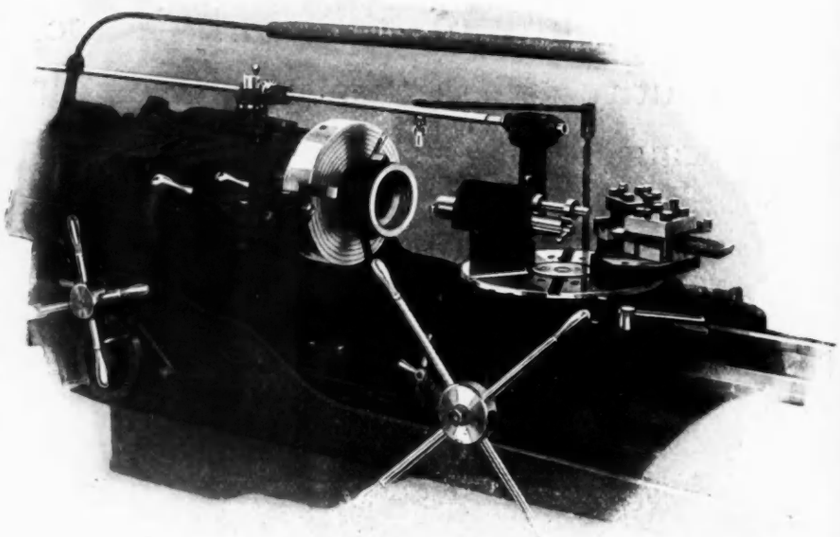
AGENTS—Marshall & Huschart Machinery Co., Chicago, Ill. The Motch & Merryweather Machinery Co., Cleveland, O. Chas. G. Smith Co., Pittsburg, Pa. C. H. Wood Co., Syracuse, N. Y. Pacific Tool & Supply Co., 556 Howard St., San Francisco, Cal. Williams & Wilson, Montreal, P. Q. Chas. Churchill & Co., Ltd., London, E. C., England. Fenwick Freres & Co., Paris, France. Heinrich Dreyer, Berlin, Germany. Landre & Glinderman, Amsterdam, Holland.

THE FLAT TURRET LATHE

has many features of great productive capabilities, without any of the complications that tend to make operation complex.

One of them is the **AUTOMATIC SCREW CHASING TOOL,** shown here, which greatly extends the range of the turret lathe and produces a screw thread known to be absolutely true with the other cuts taken at the same setting.

See pages 12 and 13 for more details.



JONES & LAMSON MACHINE COMPANY

SPRINGFIELD, VT., U. S. A., AND 97 QUEEN VICTORIA ST., LONDON E. C.

DIAMOND TOOLS.

Special Shaped Carbon, Black Diamond, Pointed Tools maintain their sharp cutting edges for months on **Hard Rubber and Fibre,** no matter how impure; they can be sharpened and will last for years.

Thomas L. Dickinson, M'f'r.,
47 Vesey St., New York.

C. W. Burton, Griffiths & Co., London, Sole Agents for Great Britain.

KINKS If you haven't bought at least one of the ten Hill **KINKS** Kink Books in the past six weeks, you are just six weeks behind the great number of active, progressive ambitious men who have siezed this opportunity. The best little helpers a man can have, only 50 cts. apiece (2/6)—beautiful books—and full of meat. Don't delay. Send for Circulars now.

HILL PUBLISHING CO., 505 Pearl St., New York.

Black Diamond Files and Rasps

PERFECT ALWAYS

Twelve Medals Awarded at International Expositions

For Sale Everywhere

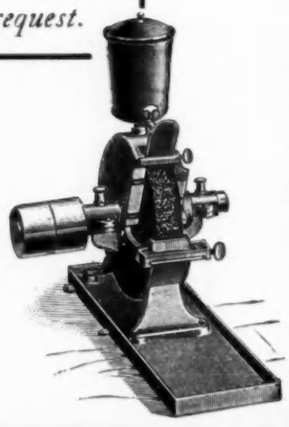
Copy of Catalog will be sent free to any interested file user on application

G. & H. BARNETT CO., Phila., Pa.

THIS is our No. 2 Bench Tool Grinder (tight and loose pulley). It is *ideal* for sharpening machinists' tools of all kinds, running emery wheels in water. Takes so little bench room that a number can easily be located on each floor in large shops. *Catalog on request.*

Diamond Machine Company

Providence
R. I.



A Double-ended Spindle Boring Lathe

Details of the Powerful Machine Built and Used by the R. K. Le Blond Machine Tool Company for Boring Its Various Kinds of Spindles

BY W. F. GROENE*

This machine has been designed for deep-hole drilling, and is used almost exclusively for boring our lathe and milling-machine spindles, which range in length from 23 inches for our 12-inch lathe spindles, to 55 inches for our 36-inch lathe spindles. The diameter of the hole in each of these, respectively, is 1 3/16 and 2 9/16 inches in diameter.

taneously from each end of the machine by the drills held in the turrets.

These turrets, which slide directly on the V's of the bed, have power feed and automatic stops, and carry the drills and other tools for boring the taper at each end of the spindle, as will be described later. In practice, one of the stops is set slightly in advance of the other, to

sure keeps the cutting edge clear of chips and the large amount of lubricant carries away the heat.

The machine is driven by a 7½-horse-power 3 to 1 variable-speed motor, mounted on the ceiling. The connection is made with a belt to the driving pulley on the machine. The controller is mounted on a bracket, near the operator. The

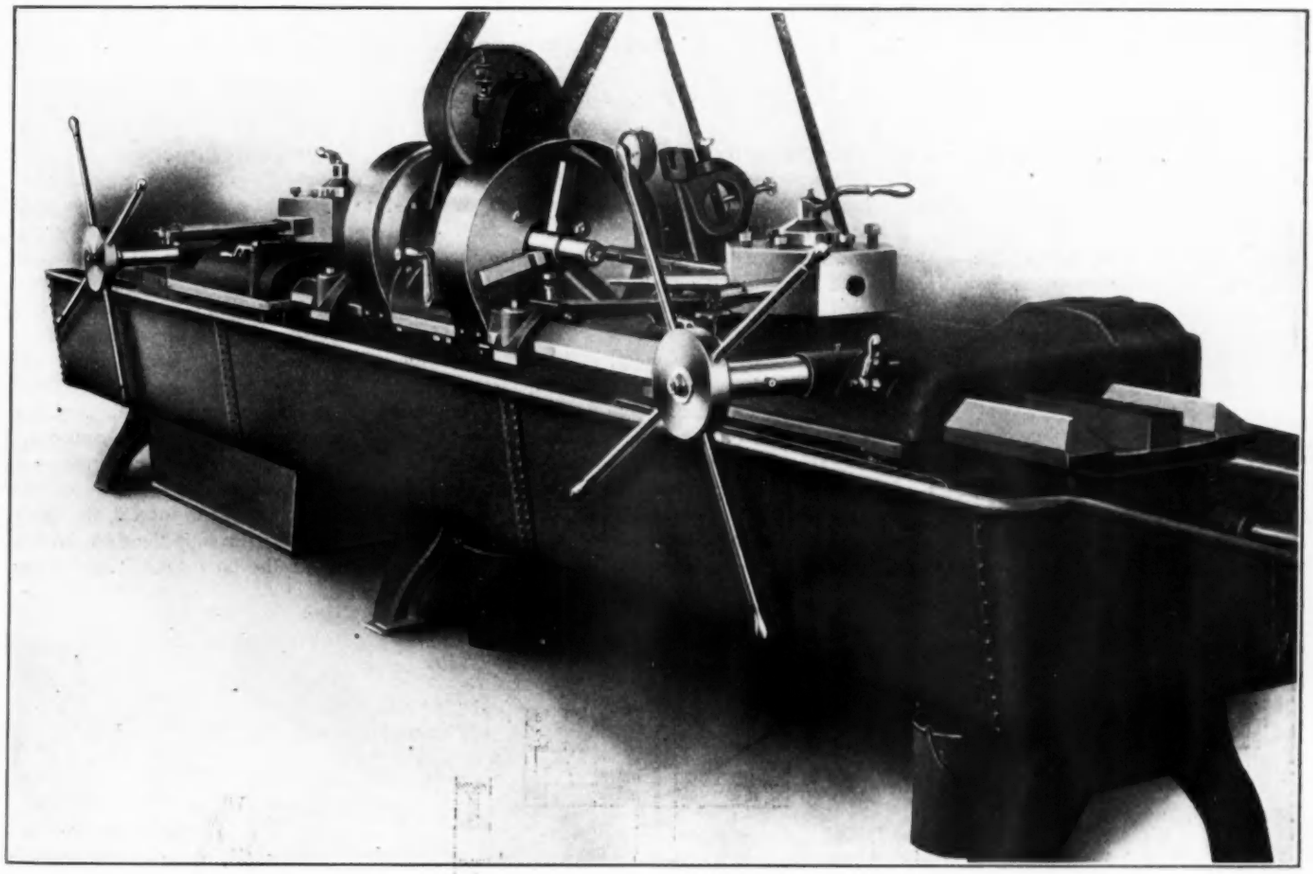


FIG. 1. SPINDLE BORING LATHE OF R. K. LE BLOND MACHINE TOOL COMPANY

Besides drilling the hole, a taper is bored in each end, one end for the lathe center and the other for the taper plug, on which the spindle is finish turned and ground. We have been running this machine for about six months, with good results and as the design is entirely different from all previous machines we have made for this purpose it may be of general interest.

The headstock is mounted in the middle of the bed, and the headstock spindle has a chuck on each end. By this method of driving the spindles are bored simul-

*Chief draftsman, R. K. LeBlond Machine Tool Company.

prevent the drills from meeting in the middle of the hole.

Provisions are made for supplying an abundance of lubricant to the cutting point under high pressure. For this purpose we use a Deming duplex pump, which sets at the rear of the machine and is driven independently, from a countershaft.

The working pressure carried is 175 pounds per square inch, which is approximately the pressure at which the lubricant is delivered to the cutting point of the tool. Ample means are provided for filtering and returning lubricant to the supply tank, underneath the machine. This pres-

driving-pulley shaft has a pinion on the end and drive is through a raw-hide intermediate gear to the gear or ring bolted directly to one of the chucks.

Headstock and Turret

The spindle is a cast-iron sleeve, flanged at each end to receive the chucks. It runs directly in the head casting and is lubricated with the two oil rings, seen in Fig. 2. Thrust is taken against the head, at one end, and against a hardened ring made in halves for assembling, at the other. This ring is adjusted by four screws, two for each half of the ring, as shown. There is no excessive

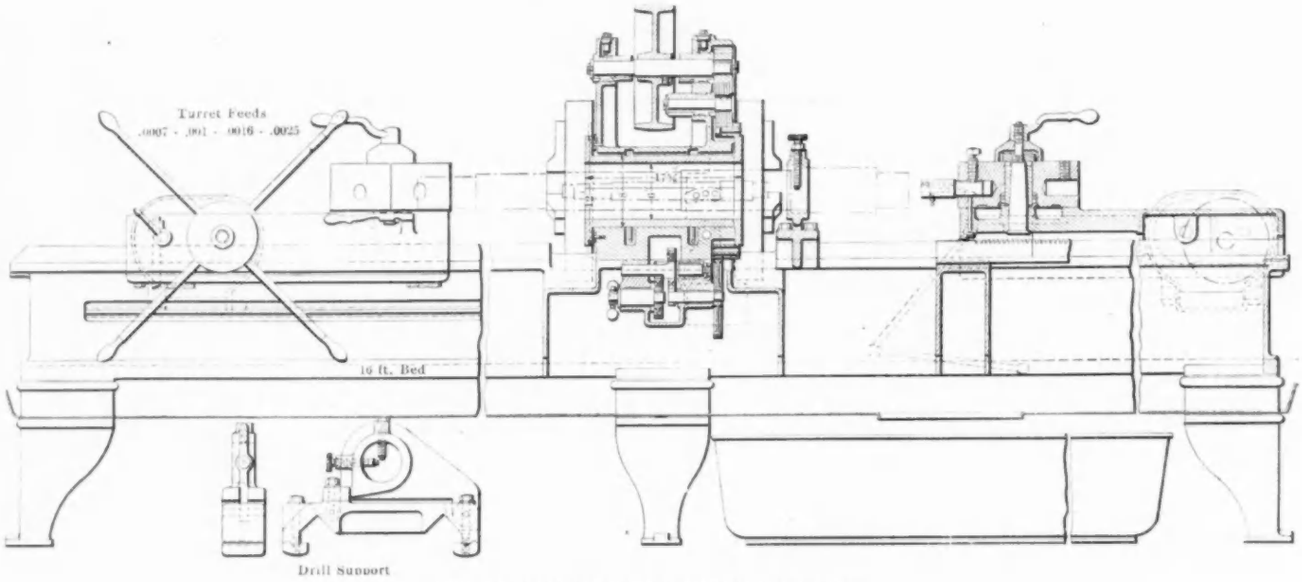


FIG. 2. DETAILS OF SPINDLE BORING LATHE

thrust on the spindle, as the cuts tend to balance each other.

Each turret consists of a single slide and is gibbed to the bed on which it slides. The rack in which the pinion shaft engages, is bolted in the middle of the bed. The pilot wheel is loose and allows the turret block to revolve with the long drills, and can be engaged with the shaft by means of a clutch.

Turret Feed

The feed is driven from the driving gear on the chuck, through a series of compound gears, under the headstock and then with a chain to the feed box at rear of the bed. The construction of the feed arrangement on these turrets is the same as that employed on our standard turret lathes. The machine has six changes of feed, ranging from 0.0007 to 0.0025 inch and operated by a lever on the headstock. The dogs for tripping the feed are carried on the front of the bed, as will be seen in the photograph.

Two steady rests, one at each end, close to the head, are provided for supporting the drill. Two adjustable screws, one at the top and one at the side, are used for centering the drill and are shown by blueprint. The upper half of the rest hinges, and can be thrown back out of the way when using the other tools, and also when removing the spindle.

Supplying Lubricant

A 3x3-inch Deming duplex pump is used to supply the lubricant to the tool. We use a cutting compound made by the Cataract Refining Company. The pump is driven independently from the shop line shaft and is in continuous operation, so as to always have a full head of fluid ready for immediate use. The pump, of course, has a relief valve to take care of excessive supply and this valve is set for 175 pounds pressure. The pump is connected to a supply pipe at the rear of the machine. A valve is placed between this pipe and each one of the turrets, the valve stems extending through the bed, within easy reach of the operator. The flexible

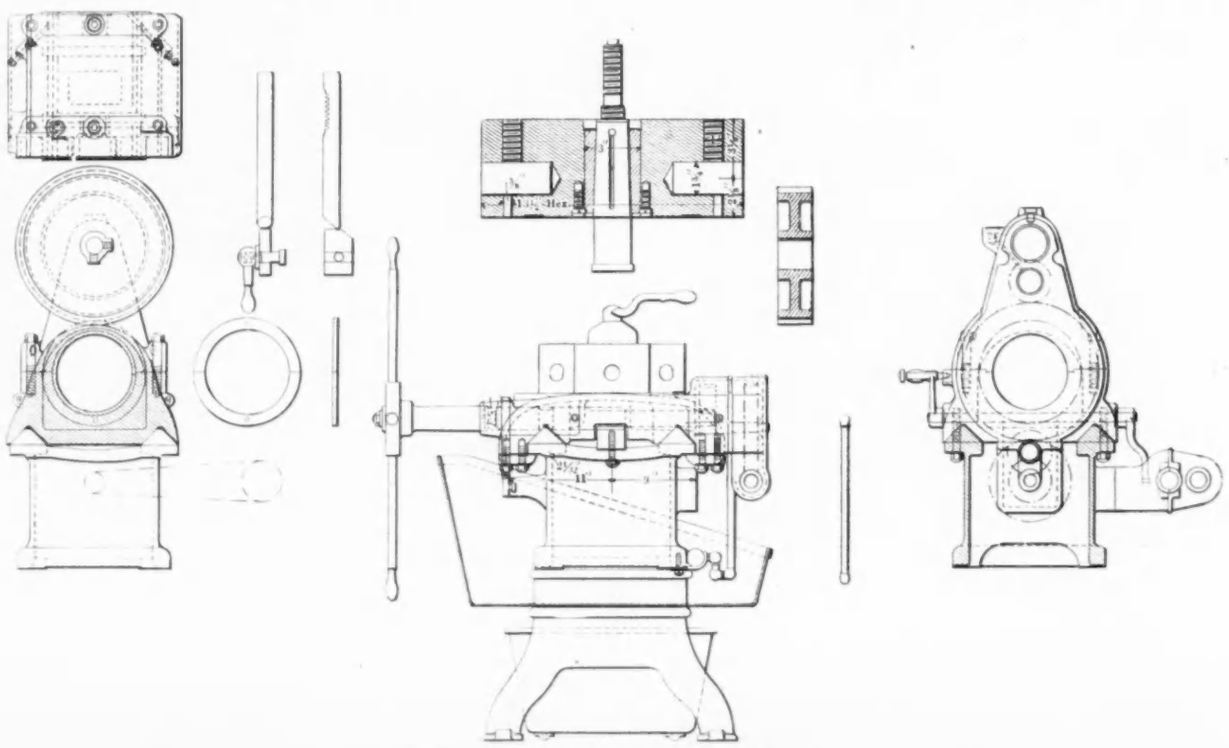


FIG. 3. CROSS SECTION AND TURRET DETAILS

connection with the turret, consisting of a pair of swinging joints, as shown, was abandoned after trial as we found them to be leaky and they would not work successfully under high pressure so that a set of telescopic tubes have been substituted. Fig. 1 shows very clearly the course followed by the lubricant through the turret to the tools.

Tools

Ordinarily, for drilling a spindle, three tools are required for each turret, a starting tool for the drill, the drill for the spindle hole and a roughing reamer for boring the taper. We use a flat drill, which we found after trying all the various styles of drills, to be best suited for this work. These are made of flat Novo steel. The end is held in the holder, shown in the machine in Fig. 1. This holder has a square hole for receiving the drill, which is held in position with a set-screw. An oil tube is screwed into the taper hole in the holder and extended the length of the drill to the cutting point. The reamer is made solid and the flutes have notched teeth. A hole is drilled through the center of the reamer, through which the lubricant is forced.

We drill the spindles, which are 50-point carbon steel, at a periphery speed of 125 feet per minute, and feed at ½ inch per minute, with each drill. Our 20-inch lathe spindle, which is 40 inches long and has a hole 1 13/16 inch diameter, we bore in 40 minutes and finish complete in 55 minutes.

Shortening the Time on a Contract Job

By F. E. Brown

The successful operation of jobbing-machine shops and foundries depends principally upon two things, quotations and the cost of work. Quotations must be so made that a reasonable margin of profit is obtained, yet great care must be exercised that the price quoted is not so high as to send the work to a lower bidder.

There is no doubt that the cost of production, even when the same number of men is employed, is materially reduced when signs of prosperity prevail so that it is often wise to take contracts at a close price to keep the shop busy, but it must not be understood that profits should be sacrificed for the sake of appearances.

After a quotation has been made, the work secured and completed, it often happens that the profit estimated has not been realized and the blame is at once laid at the door of the man making the quotation.

This is not always just, because in the shop there is a great number of ways in which these profits can be dissipated. Errors through ignorance, negligence, or carelessness; injudicious disposition and distributing of the work, which often necessitates its rehandling; failure to make proper jigs, templets or to "rig up" to the best advantage very often cost the firm considerable.

Particularly in duplicate work is it important that a little thought be devoted as to the best and cheapest way of turning out the product. Very often, when a price has been agreed upon, duplicate orders are received and the profits on the second and following orders can be greatly increased by the previous experience gained. This fact was well demonstrated by a concern that had been in the jobbing-machine shop business a number of years.

The Work to be Made

This company had agreed to furnish from time to time at a fixed price quantities of cut steel pinions as shown in Fig. 1. Having no facilities for making the blanks, these were bought at the best price, six cents per pound or about 90 cents each. A great deal of time was consumed and expensive material wasted in turning the blanks down to the required size and bevel.

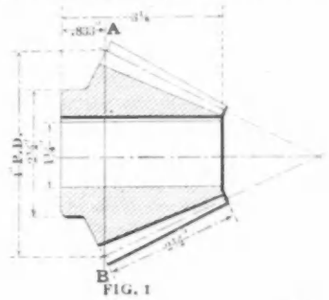


FIG. 1

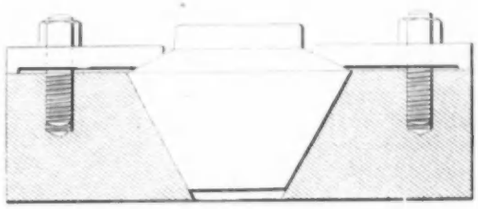


FIG. 2

CHUCKING A GEAR BLANK

This work, as well as the boring, was done in an ordinary small engine lathe. The teeth were then roughed out and finished in a bevel-gear planer.

When the order was completed it was found that the profits were not as large as had been expected, so when the next order came it was thought that a saving could be made in the purchase of the material. Instead of getting the blanks in the form of disks as before, forged-steel bars of the required diameter were bought and cut up into blanks of proper thickness. These bars cost about three cents per pound, just half the price of the former blanks.

The machine work was all done in the same manner as before, but when the job was finished, it was learned that the cost had not been reduced. It appears that the time consumed in handling and cutting up the long, heavy bars equalized the difference in the cost of the material.

Drop Forgings Cheaper

As a result, drop-forged blanks were obtained for 60 cents apiece for the next order. These forgings were made exactly to the dimensions of the piniors required, thereby eliminating all machine work with the exception of boring, keyseating and cutting the teeth.

The dies were made so as to part on the line *A B*, *Fig.* 1, thus obviating any risk of a ridge appearing on the face of the forging which might occur were the dies parted in any other way. To facilitate the boring, an old casting about the size of the face plate on the lathe was procured and bored out to the bevel of the blank so that the latter fitted snugly in the recess at the same time centering itself. Two clamps were then arranged on this plate, as shown in Figure 2, so that the blank when finished could be removed quickly and another one substituted.

Then instead of roughing out the teeth in the gear planer, as done heretofore, a special chuck or holder was made in which the blank was held, and the whole placed on a large universal milling machine, the work being done more rapidly with a rotary cutter.

The keyseat was then cut with an ordinary vertical keyseater and the teeth finished in the gear planer. This method for turning out the work proved very satisfactory, and reduced the cost of its production so that a very handsome profit was realized on the order.

The time consumed and cost of material for one pinion complete is as follows:

	Cents.
Blank Forging	60
Boring—40 minutes (Machinist @ 33c. per hr.)	22
Roughing out teeth—36 minutes (Apprentice boy @ 10c. per hr.)	6
Keyseating—10 minutes (Handy man @ 27c. per hr.)	4½
Planing teeth—54 minutes (Apprentice boy @ 10c. per hr.)	9
Total cost	$1.01½

These figures are taken as a fair average. Of course the charges for power, office expense, etc., have not been included as they will vary in each shop. One can readily see from this illustration how important it is that a little thought and planning be given to each job in the shop before it is undertaken, and it also shows that the superintendent has many opportunities of not only earning his salary and pleasing his customers by making quick deliveries, but of enabling the stockholders to enjoy handsome returns on their investment.

Engineering and Industrial Education*

Results Obtained by Coöperation between Manufacturers and the University of Cincinnati as Seen through the Eyes of a Manufacturer

BY FRED A. GEIER†

Mr. Chairman and Gentlemen: It is with some embarrassment that I attempt to address you on this subject, especially since you were privileged to hear Doctor Pritchett last night, who told you in such a clear and concise way the fundamental truths about this subject of industrial education. However, possibly what I may say may have some value, as it views the subject from the manufacturers' standpoint.

Coöperative Education at Cincinnati

Just a few words in regard to the coöperative course in engineering, as explained by Professor Schneider. There seems to have been at all times a certain amount of antagonism on the part of shop men toward men of education. When it was proposed in Cincinnati two years ago that this course should be established, the plan was laid before the superintendents and foremen to get an expression of their views of the proposition of having boys alternate on a job every other week. A multitude of objections were raised—sincere, possibly—but possibly some of them were due to the fact that there was an antipathy to the idea that any good could come from an educated mechanic; and it was against the wishes of the mechanical men in my plant that we made the experiment two years ago by accepting two of these university boys. After one year's experience, however, these same men no longer objected, but asked for all the boys of that character we could get, and we have today six of those students in our plant.

Our records show that these young men are not an expense, but that they at the present time yield a profit to the company. They are able to do the work as well, and in many cases in less time, than other men who have been in the shop for a longer period and have had a longer practical training. The system we employ in our plant places a time limit on and provides an inspection of every operation, so that every detail of each man's work is a matter of record, and these records show that in many cases the work of the coöperative apprentices costs less than that produced by the other men.

I wish you could see these young men—you would be impressed by their high qualities. It so happens that four of them are from outside of the city; one from Washington, D. C., one from Kentucky, one from Ohio, one from Indiana, and only two from Cincinnati. We have had applications from all over the land from young men eager to take up this course. The large number of applications shows that there is a very real demand for a practical course of training in engineering to fit men for the responsible positions of superintendents, engineers, and designers, and that our coöperative course meets that demand.

Industrial Education

But, while this course produces men for the higher positions, I would like to talk with you a little more about educating the great army of workmen that we must employ in our shops.

I think it is a very happy event in the history of the National Metal Trades Association, as illustrated yesterday afternoon and last night, and again this morning, that we are alive to this subject of industrial education. I claim that this question of industrial education is an economic proposition—as much a part of your business as the purchase of materials, the employment of your salesmen, your advertising men, or your managers. Consider how much time you give to the planning of your shop buildings, the time you spend investigating equipment for your plant, and the careful study you give each machine to determine which one offered will produce the greatest output. The careful attention that American manufacturers have given these matters, has been a large factor in putting them into the strong position they occupy today. But I ask you in all fairness, how much time, how much careful thought, how much consideration, have you given the subject of labor in your shops? Is it not a fact that you have dismissed that subject largely from your minds and placed it in the hands of superintendents and foremen? What do you know of the feeling toward you of the men in your shops? Have you investigated the conditions under which those men were educated and the limited extent of their education? Are you conversant with the actual relation existing between the foremen and the men in your employment? Is it not a fact that we have considered this labor more or less in the same way as we do a piece of machinery? We go out and buy it as we do a small tool and then we forget about it, because our thoughts are centered upon the larger problems of organization of our business, the expansion of our foreign markets, and similar matters which are of more immediate importance than the consideration of the conditions of labor. I ask you again, how much time have you personally given to the sociological side of the manufacturing problem?

I claim that we are dealing with a big problem, a part in the solution of which, naturally, devolves upon us. Recent legislation, State and national, gives evidence that there are already other forces at work demanding something for this labor; and unless we assume our part and give intelligent consideration to the various factors of the problem which immediately concern us, other persons or agencies will usurp our place, and I question whether they will solve the problem as wisely for the common welfare as we can do it.

Results from a School Shop

Just a few figures: We have in our plant 38 boys who are under contract with us to learn the machinist's trade. We find these boys so deficient in elementary common-school education, that they are unable to translate fractions into decimals; unable to read the simplest drawings; and in fact, unable to use tools requiring any mental effort. By inquiry and investigation we find that the average attendance of those 38 boys in the public schools is just seven years, and the average attendance of all boys in the schools of Cincinnati is only five years. Think of it, the average age at which boys leave the city schools is 11 years, and that is the kind of material you are working with in your shops today.

We found it desirable about eight months ago, realizing how imperfectly these boys have been trained, to employ a teacher and organize an apprentice school of our own. Each boy attends school two hours one evening each week, 19 boys meeting with the teacher on Tuesday evenings, and the others on Thursday evenings. The class hours are from six to eight. The teacher is himself a trained shop man, with natural ability to teach, who, some years ago, saw the need of a practical school for mechanics, and is now making this his profession. And here is the great difference between education in the common schools as we find it, and the sort of education that we are giving these boys. Instruction in our apprentice school is direct and practical. We do not ask them to recite lessons, but we teach them to solve problems, and all the problems have a direct application to the work each boy is doing in the shop.

*An address before the National Metal Trades Association.

†President, the Cincinnati Milling Machine Company.

The results that have been obtained thus far are exceedingly encouraging. Here is a paper of one of these boys showing his work last June. He has progressed until he is able to do a drawing like this. Here is another paper dated last July, one of the first lessons of the boy, and here is a problem that he did a few weeks ago in square root. Look at the character of the work. These are free-hand sketches of the pieces that the boy is working on in the shop. Now this may seem a trivial sort of proposition; but a boy that cannot do better work than this of last June, or the slovenly work like that first lesson, is likely to do pretty slovenly work about the shop; he is going to be careless about the use of the tools, careless about the finish on his work, and the accuracy of the pieces; whereas the boy who has been taught to solve problems in square root and can put them down as neatly as this, is certainly being trained to think, and is acquiring the habit of careful, painstaking, thorough and systematic work. All this will surely make a more efficient workman, and in their higher efficiency we will find ample compensation for the special training we are giving them now.

Education *vs.* Strike Breaking

It was said yesterday that this association was organized for, and its money must be held sacred and devoted only to, strike purposes. We may win our strikes, and unions may be broken here and there, but you are not breaking up, and you never can break up, the sympathy that exists between one workman and another. The affiliations of labor are the natural outgrowth of a human instinct.

We are undergoing a rapid change in social conditions; coincident with the development of business, wages are gradually going higher; the changed social conditions will inevitably bring about a shorter working day, and unless we find some solution, some way in which, by intelligent coöperation with our employees, we can raise the efficiency of labor itself, we are facing a condition under which our costs will increase, and in a short time, we may not be able to compete with other nations. But I am optimistic on this proposition; I believe that through industrial education we can in time so improve the quality and efficiency of our men as to bring about that intelligent coöperation which will permit us to pay them the higher wages, permit us to give them the shorter working day, and yet permit us at the same time to hold the cost of the unit of product to where it is now, or still further reduce it.

It does not matter much in what form we do this industrial education work. I attended both of the meetings of the National Society for the Promotion of Industrial Education, the original meeting in New York a year ago, and the recent one in Chicago, and I was intensely interested in the things that were said there; but I came back with the conviction, and this is a matter which I would like to impress upon each and every one, that the manufacturers themselves must initiate this movement, that we must ourselves make the beginning, in whatever form it may be; in our shops first, then in the community, and with such success, that the work must finally become a part of the public-school system.

The Winona Institute

Coming back to the trade school at the Winona Institute, which was discussed by previous speakers: That is a good example of what we can do as a national association. There are all sorts of trade schools, so-called, but there is only one right sort of trade school, and that is the kind we are building up in Indianapolis, which shows, that if the manufacturers take up the proposition in the right spirit, they can establish trade schools that will be profitable to themselves, and, what is more important, they will attract to these trade schools that better class of boys who have heretofore staid away from our shops.

I want to quote a part of a letter which I recently received from Wm. Gilbert, of the Buckeye Foundry Company, one of the committee of the Winona foundry school: "I feel that in the near future every manufacturer of this great country will wake up to the proposition of education of boys in the different mechanical lines. Our foundry school at Winona has been a decided success. On the 1st of March, 1907, we decided to put it on a commercial basis, and started out soliciting work from the different manufacturers in Indianapolis, the result of which was most gratifying to the committee, also to the management, and the scholars.

"I had ten letters from ten different concerns testifying to the fact that these castings were not only well made, but were as good castings as they ever used." He goes on to say, "We agreed with the boys to divide the profits"—did you ever hear before of a trade school dividing profits? "We agreed with the boys to divide the profits after all costs had been deducted, which netted them a very handsome income, some of the boys making as high as $12 per week. We find that a good bright boy with competent instructors, working seven hours per day, six days a week, at actual foundry practice, acquires more knowledge in three months than the average apprentices in our foundries acquire in one year. There is no doubt in our minds now, that a course of two years in our school at Indianapolis will turn out a finished molder."

The Progress of Germany

This is not a trivial subject; it is not a new subject either; it is very old in some of the older countries. I am going to read you some extracts from the November, 1907, number of the *Teachers College Record*, which contains a special report on the industrial improvement schools of the Kingdom of Wuerttemberg, Germany: "Out of eleven thousand recruits for the army examined in Wuerttemberg each year, only three individuals, on the average, are found to be illiterate." Illiteracy in our country, beginning with the best, is 2 3/10 per cent., and runs as high as 38 5/10 per cent. in Louisiana. In New York State it is 5½ per cent. What is the result of all this? To quote further: "Take this illustration as one of many—the single item of machinery and tools. Germany's sales to the United States have doubled in the five years from 1900 to 1905. Meanwhile, American sales to Germany, in this line are now about one-third of the totals of five years ago. For the same period, Germany now sends to England twice as many finished products, receiving only two-thirds the former imports. To Sweden, Denmark, Argentine, and Chile, Germany now sends double the quantity of machinery and tools exported five years ago, while to China it sends five times the former amount, to Canada four, and to Portugal three times the quantity sold in 1900. In the case of all other countries there has been a gradual increase of trade.

"Our consuls, importers and manufacturers who are in touch with the situation, seem to have agreed that this successful German invasion of the world's markets is the logical outcome of the greater average efficiency of her workmen."

Conditions Here

Now referring to the report of the Massachusetts commission on industrial and technical education, I quote the following: "Employers testified that 'manufacturing was becoming more difficult and more expensive'—caused by a lack of skilled workmen. This lack is not chiefly the want of manual dexterity (though such a want is common), but the want of what may be called industrial intelligence. By this is meant mental power to see beyond the task which occupies the hands for the moment, to the operations which have preceded and to those which have followed it—power to take in the whole process, knowledge of materials, ideas of cost, ideas of organization, business sense, and a conscience which recognizes obligations. Such intelligence is wise enough to see that the more it has to give, the more it will receive.

"Manufacturers confidently believe that a system of industrial education wisely planned, would tend to develop such intelligence, while it increased technical skill.

"Union men testified before this commission that they were heartily in favor of schools which would offer to men already engaged in industries the oppor-

tunity to broaden their knowledge of the principles of their trades."

Then quoting further, speaking of the elimination of the apprenticeship system: "The effects of these changes repeatedly brought to the attention of the commission, are not most serious, where we might naturally expect, in a lack of manual efficiency (though that is marked), but on the intellectual and moral side. There is a one-sided sense of values, a one-sided view of life, and a wrong attitude toward labor."

And quoting still further: "Bismarck inquired of the officer* in charge of the German exhibit at the Centennial Exposition in 1876, as to the effect of the comparison of German goods with those of other countries. The reply was: 'Our goods are cheap and wretched.' France stood out at this exposition as superior to all other countries in those manufactured goods which displayed skill and training. Germany took her cue from this, and entered upon a career which has brought her to the front rank in the production of goods both useful and artistic. England took her cue also. Then began the crusade for the establishment of training schools, the inauguration of manual training and industrial education in every direction, and England for a while held her supremacy."

Now listen to this: "Industrial education in its various forms in the United States is only one-fiftieth as extensive as it is in Germany. In the Kingdom of Wuerttemberg, 55 per cent. of the boys in schools are being instructed and prepared for some vocational training." The statement was made a short time ago, that less than one-tenth of 1 per cent. of the boys in Chicago were receiving the same sort of training.

Now just a few words more and I am done. There is a human side to this proposition that I think is also tremendously important. The operation of your plants is based entirely on the question of dollars and cents—you are constantly insisting on increased output—you want each department to produce a little more this month than last. The foreman upon whom you depend for this is living in the present; his wages are dependent upon how much his department produces for you this week or this month, and therefore, what human interest has he in the man under him? What interest has he in the future of the boy who happens to be in his department and who is there for the special purpose of learning the trade? Is it not a fact that your foremen do not seek to employ apprentices? I have statistics here to show that only a small percentage of shops in this country employ any apprentices at all.

Under the present system of manufacturing we are practically using up our supply of labor. We have not paid any attention at all to finding a new source of supply, nor have we given any thought to its proper training. Our very system of demanding production from the foreman who employs the men, eliminates the boy; but we, as manufacturers, are not living in the present day only, we will have to carry on our businesses tomorrow, and next year, and ten years from now, and it certainly would be wise on our part to make such effort as will enable us to recruit labor from new sources of supply and give careful heed to the cultivation of such sources of supply as we now have, to make it more efficient.

*The German commissioner here referred to was Professor Reuleaux. This low estimate of the quality of German exhibits at the Centennial made him, at the time, excessively unpopular at home, but his report is now looked upon as marking the turning point in German industries and its author as a man of rare courage in telling plain, though unpleasant truth.—Editor.

Sulphur is one of the best things for hot bearings, and is often used at sea on engine guides and crank pins. It is best used in a powdered form mixed with oil.

A Cam-grinding Rig

The accompanying illustrations show a highly interesting method of grinding cams for automobile-engine valve gears, which is in regular use at the works of the Premier Motor Manufacturing Company, of Indianapolis, Ind. The device is shown in position in the grinding machine in Fig. 1. It consists of a swinging frame mounted between the centers of the machine, a gear in line with the centers and driven by the machine, connecting with an equal-sized gear on a shaft below it, to the left-hand end of which the master cam is attached, while the cam to be ground is attached to the right-hand end. The master cam abuts against the stop piece, with which it is held in contact by a weighted curved arm attached to the fixture; this arm with its dependent hook, but without the weight, being clearly shown in the picture. It is obvious that with the turning of the gears the cam shaft revolves at the same speed as the spindle of the machine, and at the same time swings to and fro in a manner determined by the master cam, of which the form is accurately reproduced.

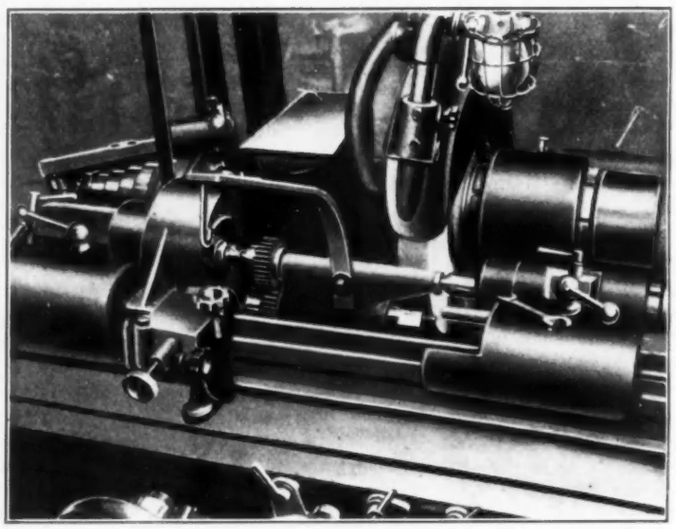


FIG. 1. IN OPERATIVE POSITION

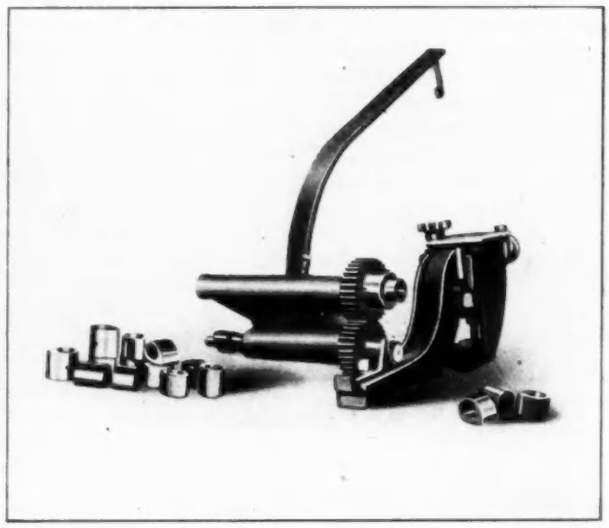


FIG. 2. DETACHED

GRINDING RIG FOR AUTOMOBILE CAMS

Fig. 2 shows the device detached from the grinding machine and viewed from the opposite side to that shown in Fig. 1. The cam to be ground is thus located at the left-hand end of the shaft, while the master cam is at the right and, as shown, behind its stop, which is attached to a bracket—the rear end of this bracket being shown in operative position in Fig. 1. In order to insure the absolute reproduction of the shape of the master cam, the stop against which it works is curved to the same radius as the emery wheel, the center of the curve being likewise at the center of the wheel.

To the best of our knowledge this is production of the shape of the master cam, chine to the grinding of cams.

Vertical Boring-mill Tools and Accessories

Cutting Tools, Work-holding Devices and Convenient Appliances for Keeping Vertical Boring Mills and Their Equipment in Order

SPECIAL CORRESPONDENCE

The engravings illustrate some interesting tools and appliances developed by the Bullard Machine Tool Company, Bridgeport, Conn., for use in connection with vertical boring and turning mills.

Combination Boring and Reaming Bar

Figs. 1 and 2 represent a combination boring and reaming bar with its cutters

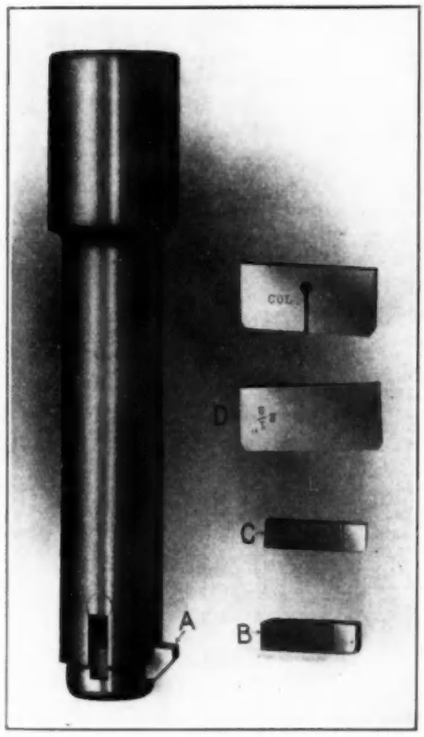


FIG. 1. COMBINATION BORING AND REAMING BAR

which are used in the following manner for machining cored holes. The chamfering cutter *A* is first employed to chamfer the edge of the hole so that the cutters that follow will have a true surface to start on and will be kept out of contact with the scale. Roughing cutter *B* is then passed through the cored hole to remove the scale and is followed by truing cutter *C*, which corrects any error due to cutter *B* following the core. Double-ended sizing cutter *D*, which is 0.005 under finish size is then run through the hole leaving the latter in suitable condition for the final or reaming cutter *E*. Both *D* and *E* are free to float in the bar and hence cannot cut large. The roughing and sizing cutters are of high-speed steel. The reaming cutter is carbon steel and may be adjusted for regrinding by means of a taper pin in a hole formed from the edge of the cutter. The method of holding the roughing cutter in the square opening in the bar and the flat finishing cutters in the oblong slot will be understood from the line drawing. It will be noticed that this combination tool utilizes but one hole in the turret, thus leaving the remaining holes entirely free for other tools.

Cutter Grinder

Fig. 3 illustrates a grinder developed especially for handling the boring-bar cutters. The cutter is held on a swiveling chuck and passed to and fro by hand across the face of the cup wheel. The slide carrying the work is light and so mounted as to be easily reciprocated past the wheel. The cutter rests against a stop and is first squared upon the edges and then the table is tilted to give the clearance angle on the ends. Graduations show the settings for both the relief of the cutting lands and also for the greater clearance back of the lands, the land on cutters 3 inches and under, usually being relieved from 2½ to 4 degrees while the clearance back of the land is 10 degrees. The cutter grinder also takes care of the beveling of the cutters on the front of the corners and grinds the desired relief toward the rear or heel of the cutter. The work is reversed against an adjustable step for the operations on opposite ends and uniform results are obtained with certainty. The required diameter is also readily secured by means of the graduated dial on the cross-feed screw of the work slide. A sizing cutter and a reaming or finishing cutter are shown in Fig. 2 and the various angles as ground are clearly indicated.

Standard Size Blocks

In Fig. 4 is shown a set of handy size blocks which are made of tool steel, hardened, ground and lapped. The blocks are for single dimension only, the nineteen in the set giving sizes of 1/64, 1/32, 1/16, ⅛ inch and then ranging by eighths to 2 inches. They are intended for setting tools on boring mills, are equally useful for planer work and may be combined to give the hight required. The blocks are, of course, not intended to form standard reference gages, but are for regular daily use on the machines and are accurate to within 0.0005 inch.

A Leveling Block

The line drawing, Fig. 5, illustrates a

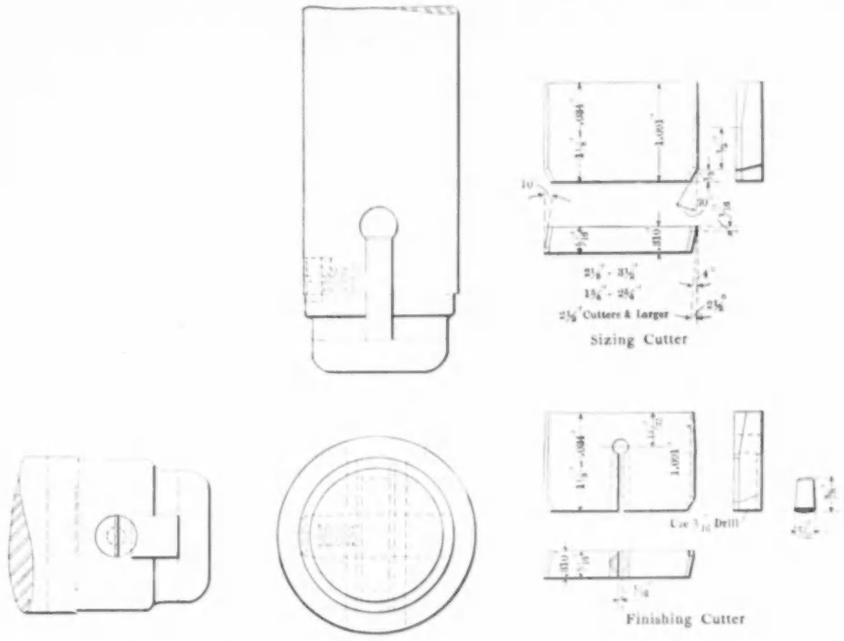


FIG. 2. COMBINATION BORING AND REAMING BAR AND CUTTERS

type of leveling block manufactured by this company for service under heavy boring mills, planers and other machine tools. The block is so proportioned that it will take the place of two bricks ordinarily used in foundations. It will be noticed that the upper or leveling plate, which comes immediately in contact with the

foot of the machine is provided with a lead pad forming a seat for the machine, which will prevent it from being jarred off by vibration. The wedge-shaped plate is readily adjusted in either direction by the two opposing screws.

Device for Testing Squares

The tool represented in Fig. 6 is built for facilitating the maintenance of accuracy in shop squares which are used for testing machine uprights and other members. The base of the device is really a carefully scraped surface plate to which is attached an upright support for an adjustable straight-edge whose sides are parallel. The square to be tested is placed on the surface plate with the edge of the blade against the edge of the straight-edge which is then adjusted to bear equally against top and bottom of the blade. The straight-edge is clamped and the blade of the square then placed in contact with the other side of the straight-edge. In this position if the square bears equally at the top and bottom it is accurate. If it does not bear equally at both points the opening between blade and straight-edge can be measured and dividing the amount by two will give the actual error. The square can then be corrected.

Tool Equipment

A standard tool equipment for a boring mill is shown in Fig. 7. In this view, in addition to the cutting tools are illustrated a number of holding devices, among them a convenient set of screw dogs which, if desired, may be used in conjunction with the combination chuck where the gripping surface on the work is short. The set of adjustable blocks are further conveniences for facilitating the locating and securing of work on the boring-mill table. These have ratchet teeth cut square with the base to hold the adjustable shoe at any desired hight.

Combination Tool Holder

In Fig. 8 is shown an O. K. tool holder and set of tools for use in the turret heads of vertical turret lathes and boring and turning mills. The holder for these tools is forged from high-carbon machinery steel, and the cutting tools themselves are forged from high-speed steel and ground to the forms shown. The holder with nurled handle is used when regrinding the cutters. These O. K. sets are made in several combinations for both the vertical turret lathe and boring-mill.

Tool Stand

The tool stand in Fig. 9 is provided with shelves which revolve on the vertical support, and which are arranged to carry the

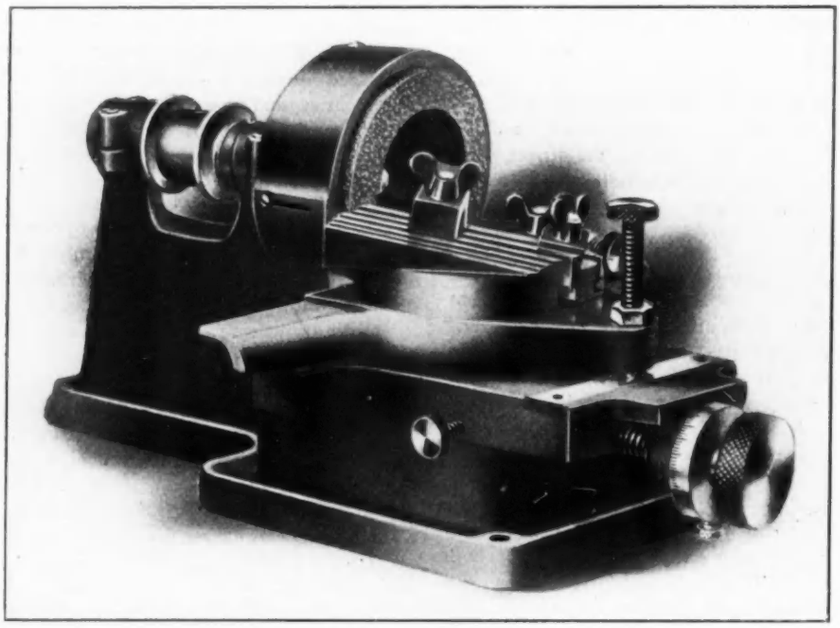


FIG. 3. CUTTER GRINDER

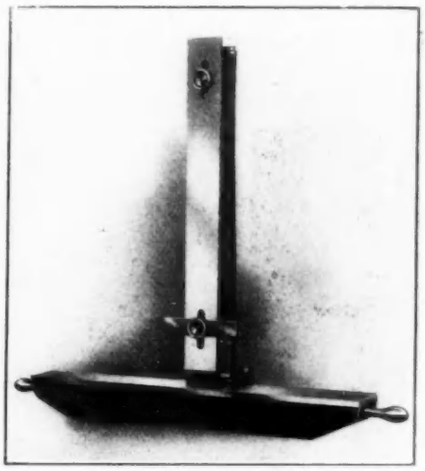


FIG. 6. A SQUARE TESTING DEVICE

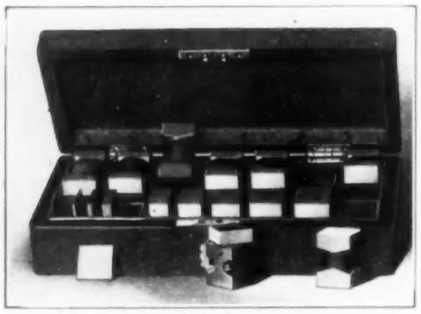


FIG. 4. A SET OF SIZE BLOCKS

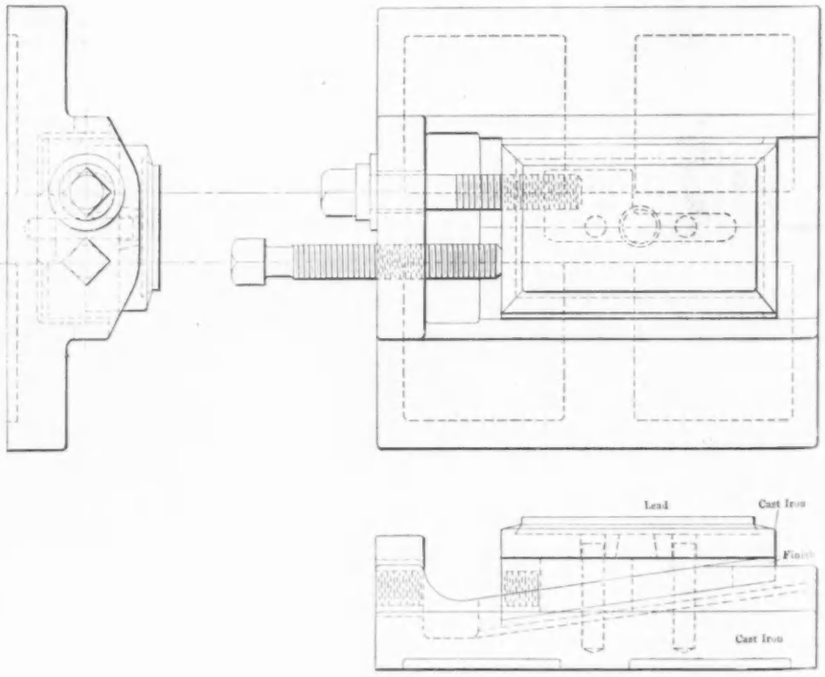


FIG. 5. A LEVELING BLOCK

different tools ordinarily used on boring mills. The entire stand is of metal and, as will be seen, is accessible to the operator at all times.

Experience with the Piece Work and Premium Plans

By Clinton Alvord*

Under the day's-work plan the employer finds fault with the foreman for the undue cost of things and strives, by pressure of scolding and stirring up of pride, to increase the output. The high cost leads to the adoption of piece work, and the workman is told he must make articles for a stated price in the future. The employer then waits until the workman who had been earning say $12 per week by day's work has climbed to say, $16.50 per week, and then he cuts the price. If the employee refuses to undertake the work at the new price somebody will; if he keeps on at the new price he learns the lesson his employer has taught him, as he now knows his pay limit. Would he not be foolish to exert himself sufficiently under the new price to get up to the old $16.50 per week again? Let me give an illustration. A well known manufacturer was discussing cost systems with me. His plan was piece work with continual cuts. He claimed the men loafed and never did within 30 per cent. of what they could; and to prove it told the following incident. A workman had been with him for some five years, and as his work had been on one line most of the time they had his production within close limits. The price had been cut several times. The workman left for some reason and a new man was put in his place. The first day the stranger increased the output almost 25 per cent., and the second day it went up to 35 per cent.; but the third day this production dropped to the figure of the first man and stayed there. I remarked that his shopmates had told the new man he was simply working for a cut in price and our manufacturer admitted that this was probably the case. I tried to show that the men had been well educated, and had learned their lesson, but my friend could not see it and claimed they were simply loafing.

The incident just mentioned shows that the piece-work plan, as an instrument for decreasing cost, tends to defeat that object after the first one or two cuts.

It is in appearance a system of rewards in which the man who works the hardest gets the best returns, but the cuts will come, and a cut is a punishment for do-

*President the Worcester Loom Company.

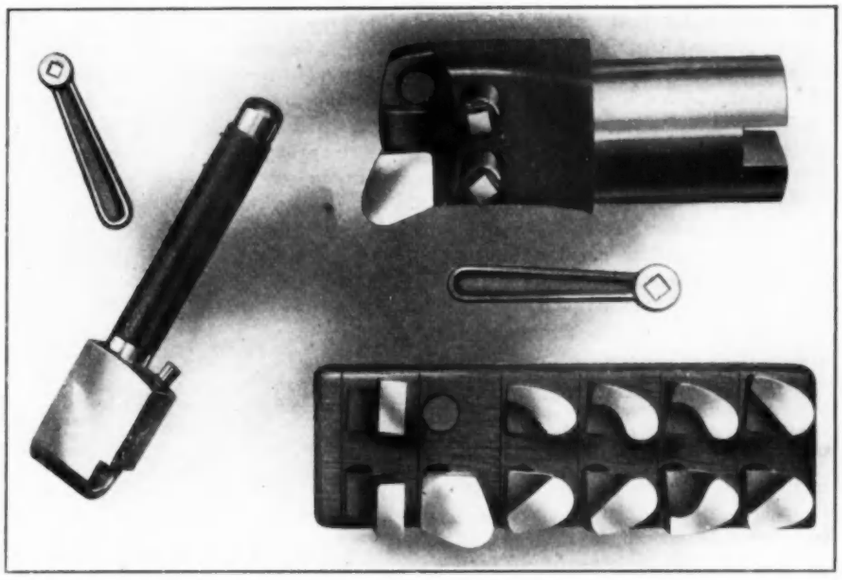


FIG. 8. O. K. COMBINATION TOOL HOLDER

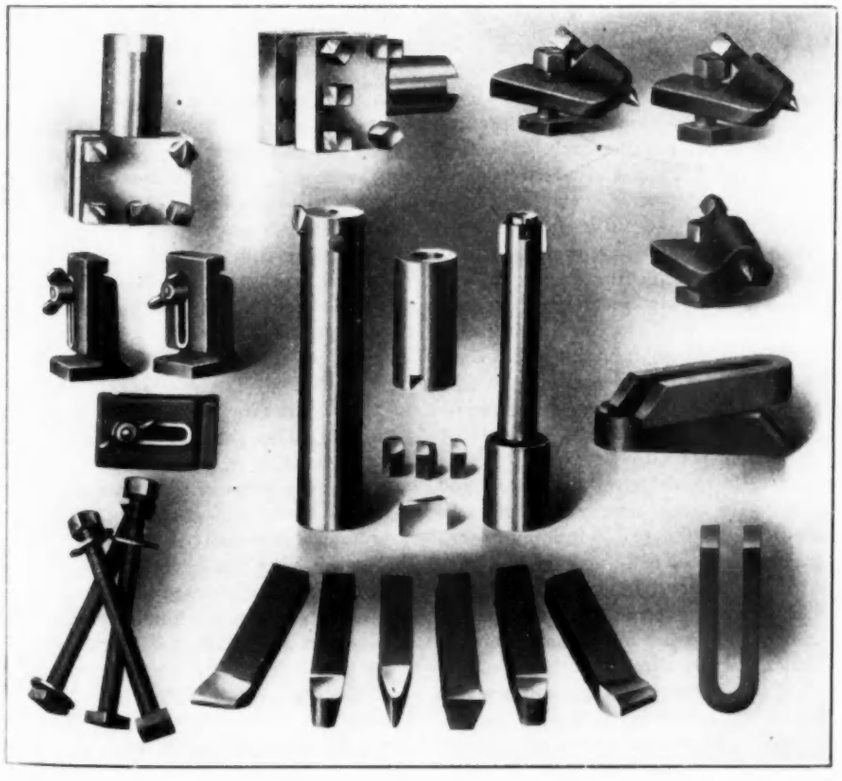


FIG. 7. STANDARD TOOL EQUIPMENT

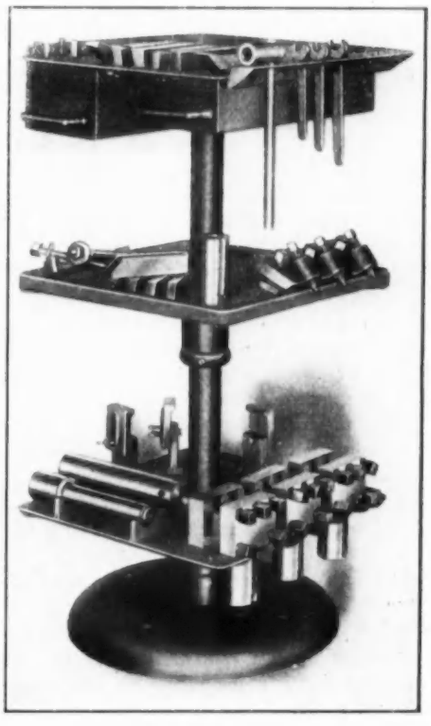


FIG. 9. TOOL STAND

ing well. The lazy man on piece work is not cut; it is the energetic worker making the large production who is punished. The good man finds he must work harder after a cut to get the same pay; and is there a reader of this article who would keep up the pace for daily increase with the knowledge that cuts were coming?

The piece-work and cut system results in greater output and less cost than under day work, but the spirit of progress is checked. The workmen push their earnings as near the cut limit as they dare and then stop making further effort.

About six years ago I was talking with an intelligent American workman who had been on the same work for over 15 years. He was turning cast-iron pieces at a speed of 24 feet per minute using Mushet steel. I described the new high-speed steels and argued for a speed of at least 50 feet per minute, as the iron was soft and the chip light. Finally my friend said, "Well, Mr. Alvord, I have been cut three times in the past 15 years and what is the good of getting it again? I guess that speed is good enough for me."

A number of years ago a friend of mine worked for a water meter company. A certain part of the meter was given to him at piece work, and he pushed the production, and consequently his wages, up until a cut came. He accepted the cut, rigged up some better holders and again advanced the production, and wages, only to receive a second cut. The process was continued by the devising of some new formed tools so that sizes would be maintained without the continued use of calipers and scale, and a third time the production advanced. But is it strange he had learned his lesson? When the foreman was away or busy he pushed the production up, and after hiding a portion of the finished product under the pile of rough parts near his machine, turned in a suitable number finished. He knew the danger line and was careful to keep on the safe side to avoid a cut. The parts that were hidden were brought out from day to day, and turned in to help swell the pay envelop at times when he had been working entirely at day's work.

I give these instances to show the real leading and teaching of the piece-work plan. Is there a reader who has not heard or seen similar cases?

Under day's work the employer gets all the gain of increased production; under piece work the workman gets the immediate gain. The premium plan splits the difference between these two. F. A. Halsey, of New York City, was the originator of the plan. Under it as a rule there is something wrong if the workman does not cut the time limit by one-third. The hope of an increase in dollars from extra diligence must be experienced before one can appreciate the driving force it exerts. As production increases the man's wages go up, and the cost of the work goes down. Could anything be fairer to both parties? No one can understand the impetus given to one's work by the knowledge that extra money is to come from increased effort until it has been given a personal trial.

Some may say that it shows up the superintendent and owners pretty well when a time limit is set and a workman cuts large slices from it, and the self-sufficient often say that they would never set a time limit that a workman could divide by three. Maybe not, but try it and brag afterward. The premium system certainly shows up the office, for the man who is working on "premium" has the hope of gain before him to stimulate his brain, attention and energy just as a man in business for himself is spurred on to greater forethought and more careful planning by the expectation of gain.

A friend of mine, a toolmaker, recently paid me a visit. A workman was doing a job of drilling and counterboring. A hub had cored bosses with holes for six arms, and he must drill and ream the holes 1⅓ inches and counterbore the ends of the bosses. My friend looked the job all over and gave his opinion that 2 hours was good rapid time in which to do the job. That would be 20 different operations at 6½ minutes each. The first time done the work had occupied 2 hours 24 minutes per piece, when four hubs were run through, so my friend was close to the mark. The first premium time was 54 minutes, and at the time when my friend saw the work done it dropped down to 46 minutes, and since then it has been lowered to 39 minutes when eight hubs were run through.

If the men work in gangs the reduction in time is not nearly so marked. Each man appears to be afraid he may work a little harder than his mates, and he knows the extra time gained must be divided among the rest. Premium work by gangs is good, but the gain is not so pronounced as with individual work.

The first time we put a gear blank for a 120-tooth 6-pitch gear on premium the workman almost threw up the job. He was told he need pay no attention to the premium card, but just take his regular gait, and if he earned anything it would come to him. Finally with much grumbling he began the work, but informed the foreman, most forcibly, that no man living could come within the time limit. The talk had taken up a portion of the time, but there were 12 blanks, and after the fifth one was finished our all-knowing workman began to whistle, for he found he was ahead of the game. It is a good sign when a man whistles while he is working on premium.

We have changed men several times on that turret machine, and a new man always objects vigorously to the time allowed on that large gear blank. The foreman brings out the record card to prove his statements, and finally, if the castings are good and soft, the new man will make a new record.

The objections brought forward by the workmen show clearly that as a general thing the men have no idea of the time required to do a given piece of work.

When I insisted that the shaft shown in Fig. 1 could be finished, exclusive of cutting off and centering, in 10 hours there was war in camp at once. The foreman argued that possibly it could be done in 12 hours, and we used a time limit of 13 hours, so as to encourage the workmen.

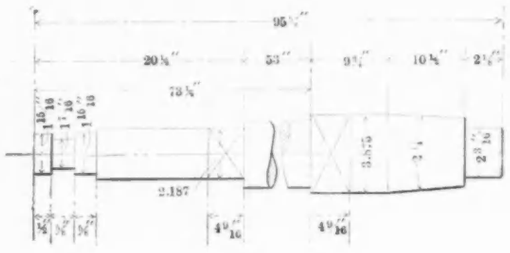


FIG. 1

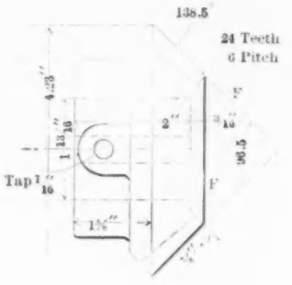


FIG. 2

TWO PIECES OF PREMIUM WORK

The first man tackling the job wanted 20 hours and the talk of 10 hours made him throw up his job. The first premium time was 9½ hours; it then dropped by degrees to 7½ hours, and by encouragement to 6½ hours, which was a record for several months. My foreman became disgusted when the time on these shafts went back to 8 and 8½ hours, and by broader cuts the next four shafts were reduced in time to 6 and then to 5½ hours. Nobody knows the shortest time in which we can do the work with our facilities. The shaft is made of 4-inch soft steel, is 7 ft. 3⅝ inches long, and weighs 326 pounds in the rough. We remove 98 pounds of metal and there are four micrometer fits.

The teeth of the bevel gear shown in Fig. 2 can be cut in a milling machine in 33 minutes when working premium and in lots of 20 or more. Our day-work time was 1 hour and 10 minutes. Good soft castings and the premium plan have enabled us to decrease the time of cutting teeth down to 48, 37, 36, 35 and 33 minutes. There are 24 teeth 6 diametral pitch, and as each tooth must be cut

twice, the young man must do some hustling to put on the blank, make 24 cuts, shift over his machine, make 24 more cuts, and remove the finished gear in 33 minutes.

The foreman can help the system along in a substantial manner and it therefore pays to enlist his help by giving him a percentage of the earnings of his men. He can grind their tools, get up new and improved tools, and help in many ways. I give my foreman a sum equal to 25 per cent. of what his men make.

There are a number of practical questions which arise for decision if the premium plan is installed. The first one strikes at the foundation stone of the piece-work plan, and I will indicate several of these questions.

First: How many times will a young and ambitious workman recover his breath and strive for increased production after he finds that the management of the shop persists in cutting the rate whenever he advances his weekly rate above a fairly definite amount?

Second: A workman has been producing a shaft similar to that shown in Fig. 1, and his time is fairly constant with lathe tools of ordinary carbon steel. If the management purchases high-speed steel at 65 or 75 cents per pound for new tools on the same job, is it fair to cut the premium time? Remember the man has more work to do in a day, the dead center has 10 times the chance of heating and grinding up, and the piece of work is spoiled quicker because the lathe is running faster.

Third: If the management of the shop cuts the time limit because of the use of the new high-speed steel tools, would they lengthen the time limit if the shaft was of gray iron, and for some reason the iron came so hard, in a certain lot of shafts, that the speed must be greatly reduced and it becomes impossible for the workman to earn a premium?

Fourth: The shop manager interests his foreman in the premium plan by giving him a sum of money that is a given percentage of the premium earnings of his men. The foreman thinks up a somewhat new method of doing a piece of work, and thereby reduces the time. Should the manager strive to encourage him to think up other ways of reducing time on other jobs by cutting the time limit because of the improved method? If the time is cut he will, of course, receive nothing in premiums for his ingenuity and forethought.

These questions are simply a few of the very practical ones that arise in the operation of the premium plan.

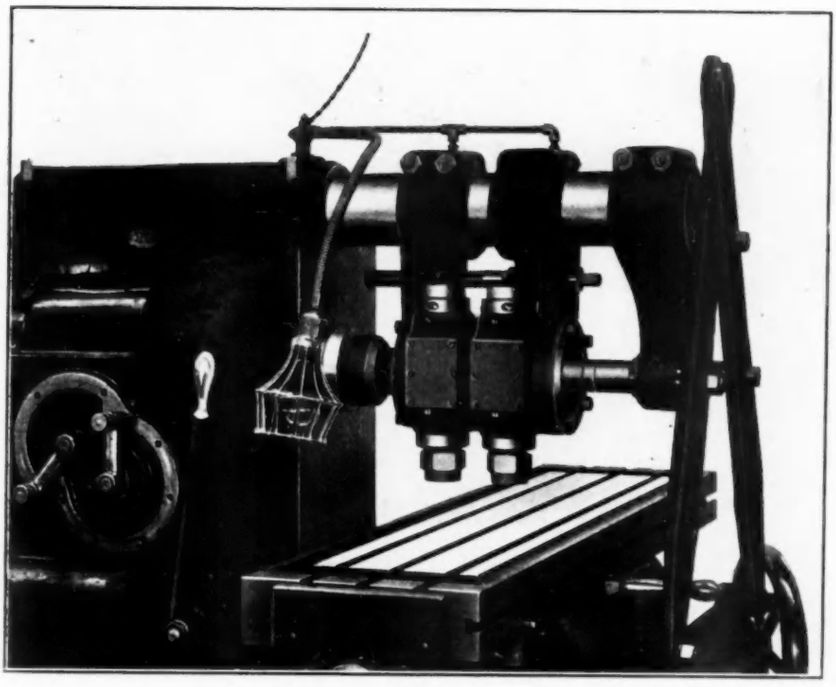


FIG. 1. DOUBLE VERTICAL-SPINDLE MILLING ATTACHMENT

A Double Vertical-spindle Attachment

The double vertical-spindle milling device shown in the accompanying half-tone illustration and line drawing of details was designed by the Kearney & Trecker Company, Milwaukee, Wis., for some of their special work, and makes an interesting addition to vertical-spindle milling attachments.

From Figs. 1 and 2 it will be seen that this attachment is supported from the overhanging arm and driven by spiral gears from the main spindle of the milling machine. The design allowed the use of larger gears on the main than on the vertical spindles and makes it possible to make the angle of the spiral gears very favorable for a drive of this kind. The angles are 54 degrees for the driving and 36 degrees for the driven gears.

The work to be milled is chucked in the regular way and the table fed to the left as we stand facing the front of the machine. This particular work had two shoulders as shown in Fig. 3, and on this account it was decided to run one spindle right-hand and the other left so that both cutters would be running against the cut on the shoulder *A*.

It was also necessary that the distance *B* should be maintained at some fixed standard in spite of any wear to the cutter, which accounts for the side adjustment shown in the first two views. After the machine was once set up this fine adjustment amounted to 1/4 inch, although it is

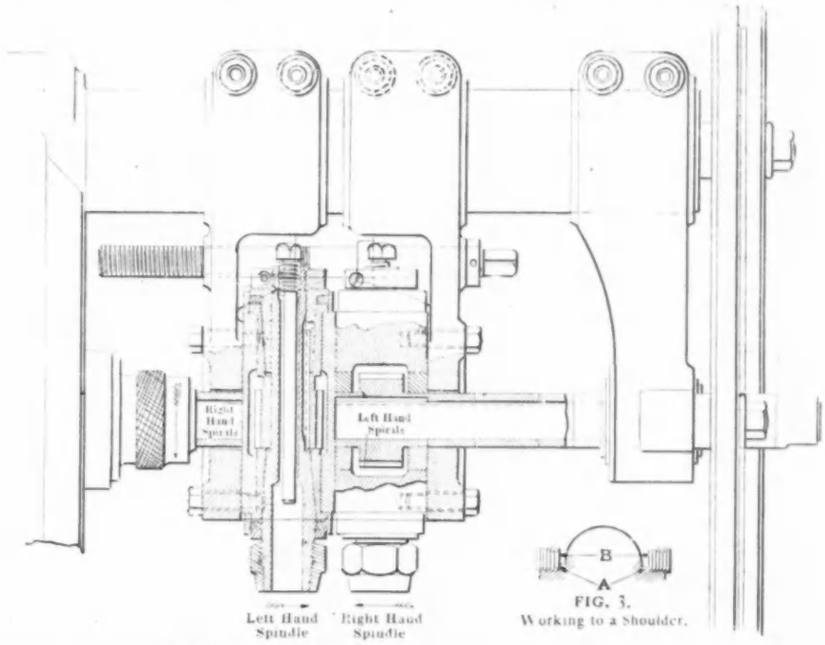


FIG. 2. Section through Spindle.

FIG. 3. Working to a Shoulder.

evident that could be greatly increased by furnishing a spiral gear on the arbor to take its end thrust against the bearing in the housing in place of against the arbor itself. This would mean, of course, the use of an arbor without arbor collars.

The casting containing the spindle bearings was made separate from the piece that clamped around the arm on account of the convenience such an arrangement affords in getting the spindles square with the top of the table.

Cutters and arbors used in these spindles have straight shanks and are backed up by the screws shown through the hollow spindle. This permits the slight vertical adjustment of one cutter in order to bring them both to an exact level when such adjustment, as is often the case, becomes necessary.

The method of lighting the work on this machine is a little out of the ordinary, and consists of a piece of Almond flexible tube screwed into a little bracket which is fastened to the machine itself. This has been found to allow the light being brought into better position with regard to the cutter and the work than any arrangement they have tried.

Making Dies for Wire Drawing

While there is very little to a wire-drawing die as we see it in place in the drawing machine or bench, the making of it is somewhat out of the usual line of machine work and its details are interesting.

These blocks or dies are cast of a special hard-iron composition and to still further increase the hardness are made in an iron mold or chill. This makes a very hard die suitable for drawing wire, yet from the nature of the mixture, a metal tough enough not to be brittle. The fracture looks harder than most castings we are apt to see.

These dies vary in size from the small round castings shown on the floor, say 1½ inches in diameter to the larger strip dies of perhaps 2½x8x1 inch thick. A portion of the molding floor of the die department of the McFarland Foundry & Machine Company, Trenton, N. J., is shown in Fig. 1 and gives an idea of the way in which the molds are bunched and poured. Details of the mold are shown in Fig. 3. The top which carries the pins rests in the mold in such a way as to leave the end opening for pouring. The men pour until the metal is level with the under side of the top and get them very uniform indeed.

The number of holes vary, five being shown in Fig. 2 while sixteen are used when the holes are to be small. Some of these can be seen in the front row, both with and without pins. The hole in the die is tapered as shown in the section in Fig. 3, this being produced by the iron pin which sets through the top and rests its point on the bottom of the mold, this point making the small hole which comes through the casting at the face. These points do not always quite break through, particularly on the small sizes, but that is a detail which can be corrected when it comes to finishing the dies for use.

It will be noted that these die molds rest on steam pipes and two connections can be seen at the left coming down from the leader. This is for heating the molds before pouring so as to insure good castings and dry out any moisture that might be in the molds. The exhaust steam from a small engine and from small steam hammers which swage down the ends of the pins serves for heating. This steam is not necessary after the first heat

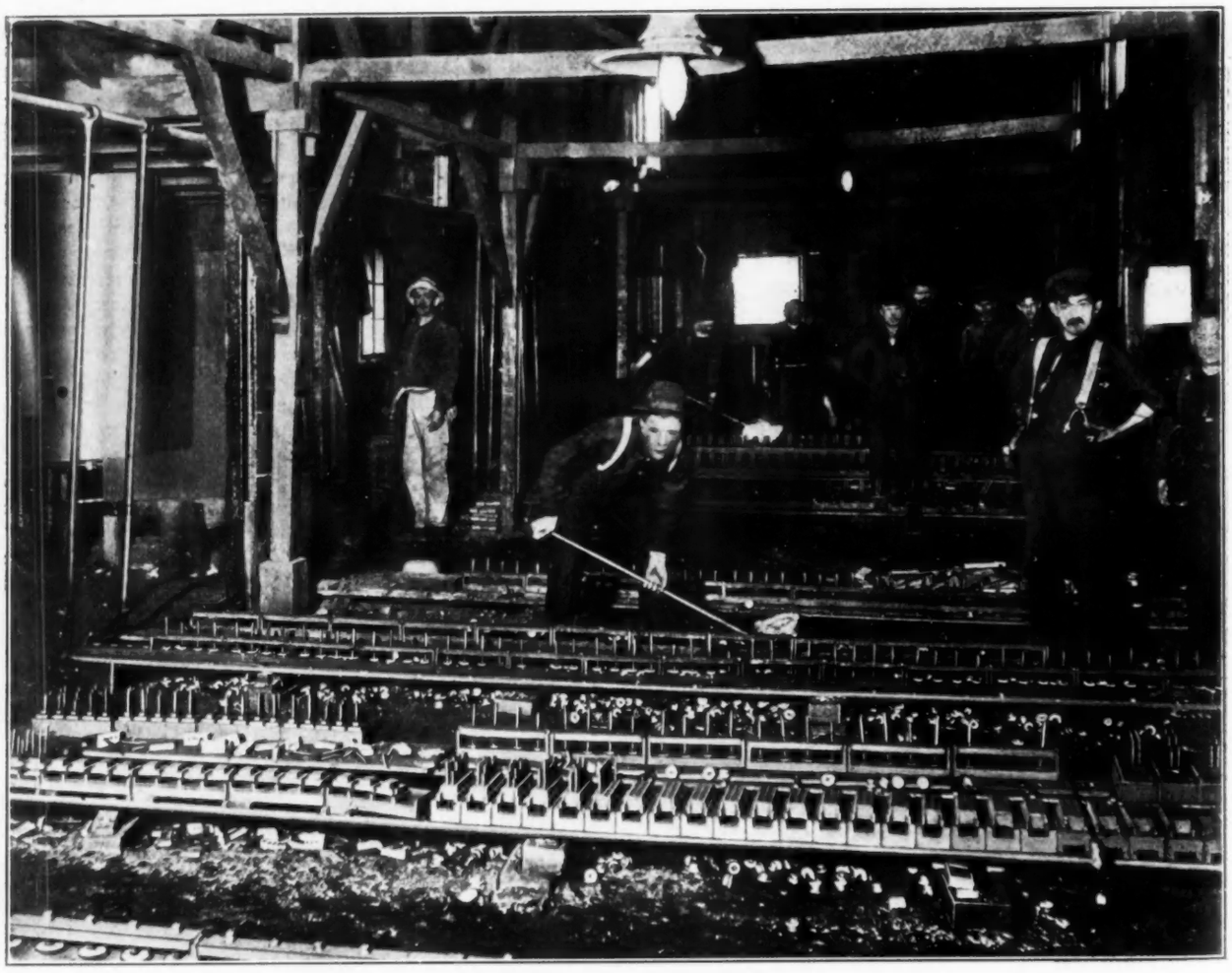


FIG. 1. PORTION OF DIE FOUNDRY—McFARLAND F. & M. CO., TRENTON, N.J.

has been poured, as the castings warm the molds up for future pourings.

The molds are set, the pins placed in their holes, the castings poured and then the boys commence to open up the molds, jarring the tops so the pins fall to the floor. Then new pins are inserted as fast as possible and the molds set over again for the next heat, which is poured as soon as the ladles get around the first time. This takes a tremendous quantity of pins, as it is not uncommon to pour five heats in the afternoon and the pins must be ready beforehand, as very few can be used more than once before being repointed.

These pins are made from iron rods of commercial sizes cut off and drawn down to nearly the right size under the small steam hammers which are adaptations of Harthan's pneumatic hammer, one of the first tools of this kind I ever saw. They are finished by grinding on emery wheels, the morning being devoted to making up the supply of pins and the afternoon to making the castings.

After these are received by the wire mill where they are to be used, the holes have to be finished to the exact sizes, which vary from one end of the block to the other, so that each successive drawing reduces the wire a little until the last makes it the correct size.

The finishing of these blocks is quite a problem on account of their extreme hardness, but it is done with high-grade tool steel, not high-speed steel, hardened in the usual way. The first move is to countersink the back side of the die block with a flat countersink or drill which breaks through into the holes when they do not happen to go clear through. Then a square reamer with a shape something like the point on the rod is run in from the other side to clean out the hole. The final sizing of the throat of the hole, which does the real work of drawing and sizing the wire, is done with a separate reamer and carefully worked out to size. This is a rather ticklish job, but those who do it soon get accustomed to it and the dies are made very quickly. The main precaution is to run the drills and reamers very slowly as in the case of turning chilled iron rolls for rolling mills.

The McFarland Foundry has been making these dies for many years, and it is somewhat surprising not only to see the amount of dies they turn out in a day's run, but to note the small number of defective castings.

F. H. C.

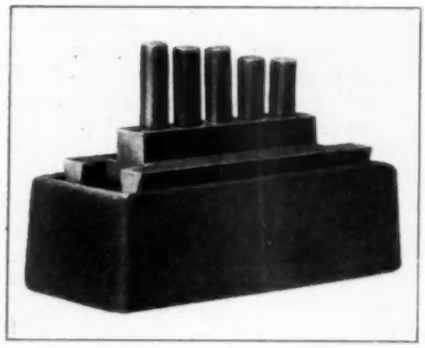


FIG. 2. A SMALL MOLD READY TO POUR

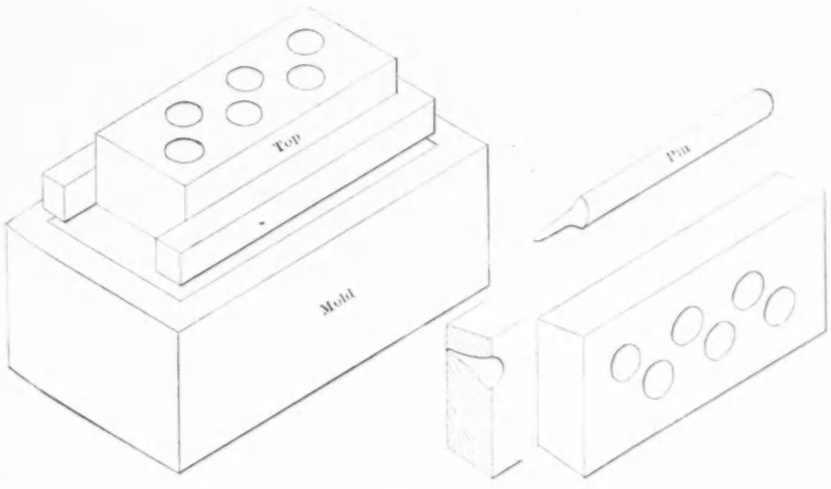


FIG. 3. SOME DETAILS OF THE MOLD AND DIE

Complete figures for the exports of machinery for 1906 and 1907 are now available, and show a gross increase in value of from $107,998,000 to $120,784,000. The largest increase is found in mining machinery, for which the figures stand $2,837,000 and $6,125,000 for the two years, respectively. Next on the list in the order of increase is metal-working machinery for which the figures are $7,913,000 and $10,142,000. The greatest portion of this increase went to Great Britain, the figures for that country being $1,594,000 and $2,112,000. For Germany the figures are $2,190,000 and $2,247,000. All countries reported on show an increase except Italy, for which country the figures are $1,023,000 and $953,000.

Straightening a Locomotive Frame

By David R. Llewellyn

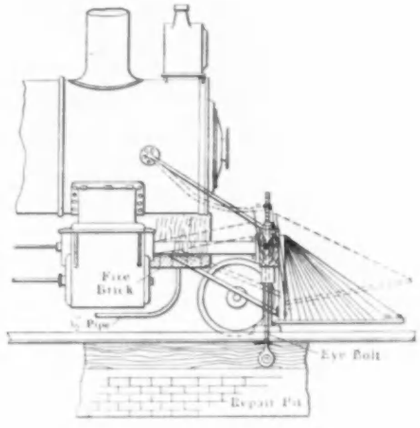
We had a job the other day which may be of help to some of your readers in locomotive shops, or work of a similar nature.

A heavy passenger locomotive came in with a bent front frame, the bend occurring just ahead of the saddle, so that the pilot turned its nose up in the air about a foot. Needless to say, the engine was wanted as quickly as possible, as is always the case in railroad work; so we took off the pilot brace which was bent and used one of the bolt holes through the cross or pilot beams in front for pulling the ends of the frame down into place.

We bored a 1½-inch hole in the heavy timber in the pit under the tracks and drove in a piece of round iron, leaving it projecting to serve as a pin; then we made a long eye-bolt of 1⅛-inch iron, slipped it up through the end of the pilot beam and put the eye over the pin projecting from the pit. Bending up a piece of No. 8 sheet iron about 2 feet square to serve as a support for a coke fire, we put fire brick in the bottom of this to support the coke, after previously drilling a hole in the center of the sheet iron for a ½-inch gas pipe to carry the air to the coke fire so as to secure the necessary blast.

We then started up the air pump on the engine for our blast and the coke fire soon heated up the frame at the bent point hot enough to be drawn back into position by the nut on the upper end of the eye-bolt. To avoid drawing it too low we put a hydraulic jack, set at the correct hight of the sill from the track, under this end of the beam to act as a stop in drawing the frame back into position.

This method required very little help and was done in a comparatively short time which is always a thing to be desired in railroad shops where engines are always wanted in a hurry.



STRAIGHTENING A LOCOMOTIVE FRAME

The Factor of Safety in Ball Bearings

Four Balls Are Shown To Be an Advantageous Number To Use in a Bearing—A New Spherical Roller and Several Bearing Designs

BY G. T. RENNERFELT

In ball bearings of the ordinary type which contain a great number of balls a distribution of the journal pressure on several balls is expected to take place. If the balls are sufficiently accurate, and the bearing is otherwise well made and is kept free from dust and grit such a distribution of pressure undoubtedly does take place, and the bearing may operate satisfactorily for an indefinite length of time. Such a bearing, however, can have no factor of safety in the ordinary sense of the term, it is compressed enough to allow a distribution of pressure on itself and its neighbors; or worse than that, it may crack and cause the rapid destruction of the whole bearing.

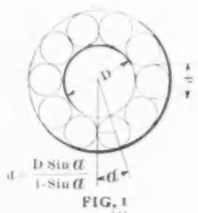


FIG. 1

FIG. 2

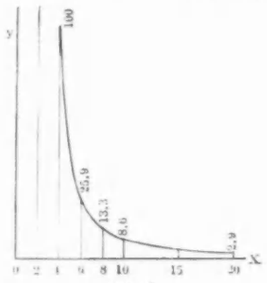


FIG. 3

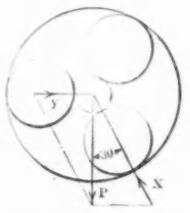


FIG. 4

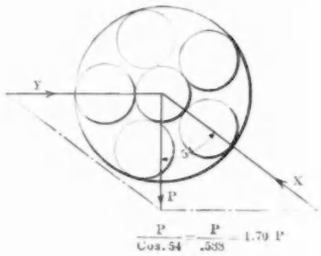


FIG. 5

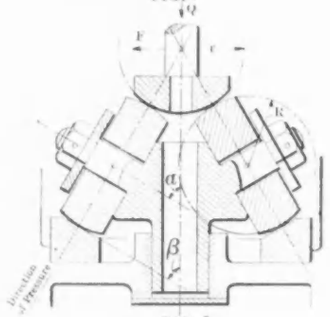


FIG. 6

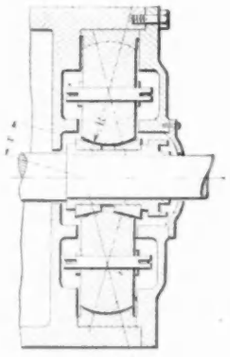


FIG. 7

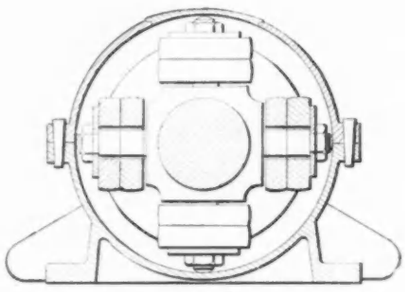


FIG. 8

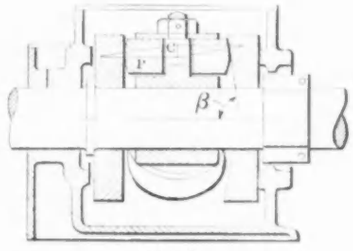


FIG. 9

DIAGRAMS ILLUSTRATING FACTOR OF SAFETY IN BALL BEARINGS AND SOME SPECIAL BEARINGS

Partly because the pressure on any one ball is *unknown*, and partly because a distribution of pressure on several balls of necessarily non-uniform size and rather small diameter presumes an appreciable compression of the balls. The balls cannot be made perfect spheres or of perfectly uniform size, and in order that a distribution of pressure on several balls may be possible the balls, or the races and the balls, must undergo compression, the amount of which will be greater with a greater lack of uniformity in the balls. The strain on the balls will be greater in proportion to the magnitude of the compression, and with an appreciable amount of compression the strain on a ball may come close to the elastic limit of the material in the ball, and then the factor of safety will be little or none. It may even happen that in an otherwise carefully built ball bearing one ball may be so much larger than the others that it will be strained beyond its elastic limit and become permanently deformed, before

Necessity of Extreme Accuracy

The necessity of the extreme accuracy of the balls in bearings of such a type is well recognized by ball-bearing makers; it was, for instance, pointed out by Mr. Hess in an article in the American Machinist, page 294, Volume 30, Part 2, that in such a bearing, which contains from 10 to 20 balls, the "permissible variations of ball diameters amount to but little more than one ten-thousandth part of an inch." This degree of accuracy is rather higher than that ordinarily required in any other detail of a machine. Although it is quite feasible to attain this accuracy with the existing ball-making machinery, it is not at all certain that when a bearing is assembled sufficiently rigid inspection is exercised to exclude a ball which may be inaccurate by one ten-thousandth part of an inch, and it is certainly beyond the ability of most users of ball bearings to detect such a small fault. Moreover, even if this accuracy exists in the bearing from the beginning it is not always certain to lead to the desired result—the distribution of the load on several balls—for dust or grit of much larger dimension than 1/10,000 inch may enter the bearing, so that the whole load may be taken momentarily on a single ball in spite of their great number.

From the above considerations it would appear preferable to arrange a ball bearing from the beginning with the view that

each *one* of the balls shall carry the *whole* load, and carry it with a reasonable factor of safety.

Load-carrying Capacity

It is interesting in this connection to consider the relation between the load-carrying capacity of a ball bearing and the number and size of the balls contained therein. Figs. 1 and 2 show two radial ball bearings arranged respectively with 10 and 20 balls of the largest possible size for the same size of the shaft. A glance at these figures will show the bearing in Fig. 1 to be the stronger, and as a general rule it may be said that a bearing having a small number of large balls can support a greater load than a bearing having a greater number of smaller balls. This is due to the fact that the load-supporting ability of the ball increases with the square of its diameter according to the equation $P = K d^2$, where P denotes the load, d the diameter of the ball and K a constant expressing the strain on the material in the ball. The load-sustaining ability Y of a ball bearing having a number of balls X may then be expressed by the equation

$$Y = \frac{X}{n} K d^2,$$

where $\frac{X}{n}$ denotes the number of balls on which the load is equally distributed.

The maximum diameter of a ball in a radial ball bearing for a shaft of given same size shaft, and in each case with the greatest possible diameter of the balls. The diameter d of the ball is expressed as the previously mentioned function of the diameter D of the shaft; K is assumed constant in each case, and for the sake of convenience it is assumed that n is 4, or that the load is sustained by one-quarter of the number of the balls.

It will be seen from the table that as far as the strain on the balls is concerned, the bearing having 20 small balls has less than 3 per cent. of the load-sustaining ability of the bearing having four large balls, even under the assumption that in the former bearing the load is distributed on five balls. In actual practice this assumption will not hold, for it may even happen that at some time the whole load will fall on one ball, thereby reducing the 3 per cent. to about 6/10 per cent. In Fig. 3 the values of Y given in the table are

Number of Balls. X	$\alpha = \frac{360^\circ}{2X}$	$\sin. \alpha$	$1 - \sin. \alpha$	$d = \frac{D \sin. \alpha}{1 - \sin. \alpha}$	d^2	$\frac{X}{4}$	Relative Load-sustaining Ability. $Y = \frac{X}{4} d^2$
4	45°	0.707	0.293	$2.41 \times D$	$5.8 \times D^2$	1	5.8 or 100
6	30°	0.50	0.50	$1.0 \times D$	$1.0 \times D^2$	1.5	1.5 or 25.9
8	22½°	0.383	0.617	$0.62 \times D$	$0.385 \times D^2$	2	0.77 or 13.3
10	18°	0.309	0.691	$0.448 \times D$	$0.200 \times D^2$	2.5	0.50 or 8.6
20	9°	0.156	0.844	$0.185 \times D$	$0.034 \times D^2$	5	0.17 or 2.94

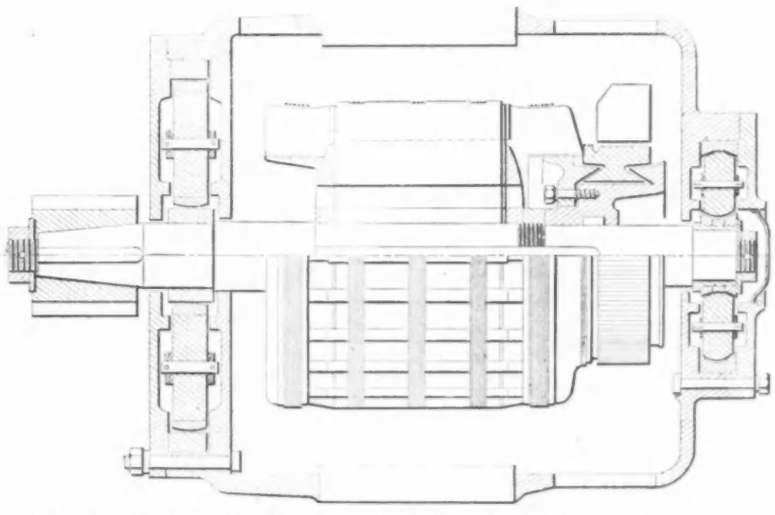


FIG. 10. AN ELECTRIC MOTOR WITH BEARINGS HAVING SPHERICAL ROLLERS

diameter is determined by the number of the balls, so that as shown in Fig. 1,

$$d = \frac{D \sin. \alpha}{1 - \sin. \alpha},$$

where D is the diameter of the shaft (or of its surrounding bushing), d the maximum diameter of the ball, and α half the angle occupied by the ball. The following table gives the relative load-sustaining ability of ball bearings arranged with different numbers of balls for the plotted into a curve; it is interesting to note that this curve resembles a hyperbola in so far that it has two asymptotes, for Y will be infinite for $X = 2$, and Y will be zero for infinite X. This point can be best understood by referring to the original equation

$$Y = \frac{X}{4} \left(\frac{D \sin. \alpha}{1 - \sin. \alpha} \right)^2.$$

Since in a ball bearing, comprising any number of balls, the whole journal pressure is liable some time to fall on one single ball, it appears simplest to confine the number of balls to the smallest number where this will happen.

Advantage of Four Balls

In a radial bearing this number is four. If the number of balls in the bearing is confined to three, the maximum pressure on a ball will amount to 15 per cent. more than the journal pressure, and if the number of balls is five, with one ball appreciably smaller or larger than the others, the maximum pressure amounts to 70 per cent. more than the journal pressure. This is illustrated in Figs. 4 and 5, where the direction and magnitude of the journal pressure is denoted by P, the diagonal in a parallelogram of forces x and y acting on the balls. If, on the other hand, such a diagram is drawn for a bearing comprising four balls 90 degrees apart the parallelogram becomes a rectangle where a side cannot be greater than the diagonal, so that neither x nor y can be greater than P; in this respect the number four occupies a unique position.

The excess of 15 per cent. above the journal pressure in a three-ball bearing is, however, not forbidding, and bearings of such type have been used for heavy pressures with great success. Much more excessive pressure sometimes exists in some common types of ball bearings owing to the faulty or uncertain direction of the pressure. Such is the case in the usual ball bearing with two races of curved cross-section when used for sustaining end thrust. The magnitude of the pressure on a ball in such a bearing depends on the clearance in the bearing; it becomes greater with a smaller clearance, is practically indefinite, and may reach any value.

If a ball bearing is so constructed that each one of the balls can support the whole load with a reasonable factor of safety no distribution of pressure on several balls will be required, the present necessity of extreme accuracy in the balls will disappear, and a great deal of trouble may be saved in the practical operation of the bearing. Such a design of ball bearing for heavy service will involve balls considerably larger than at present customarily used. In order to save weight and space it is therefore preferable in bearings for heavy service to use only the middle section of the ball; such a section of suit-

able thickness can be easily made of any diameter, and will not occupy much room in an axial direction. Compared with ordinary ball bearings it will require more space in a radial direction, but as a rule sufficient space is there available. When properly arranged in the bearing this section of a ball, or spherical roller, will retain some of the characteristic features of a ball. Thus it is distinguished from a cylindrical roller by the fact that pressures applied to its spherical surface will be directed through its center, while pressures applied to the cylindrical roller will *not* have definitely known directions. Such pressures centrally directed cannot form a couple acting to tilt the spherical roller, neither will they have an axially directed component which would tend to displace the roller laterally, and for these reasons the spherical roller can be guided in its proper path by very simple means which do not cause appreciable friction. This spherical roller can be used in both end thrust and spherical bearings, and can be made of any size required to sustain a heavy pressure.

Some Special Designs

Fig. 6 shows such spherical rollers arranged to sustain end thrust from a vertical shaft, and at the same time to form a self-alining side bearing for the shaft. For a high-speed shaft the angle β of the conical track may be given such a value that the centrifugal force acting on a roller will be counterbalanced by the resultant of the two pressures on the roller from the track and from the upper spherical race. The ratio between the speeds of shaft and spider is

$$\frac{2\,(R+r)}{r} : 1.$$

In this form of bearing only three equally spaced rollers should be used; if the end thrust on the shaft is Q and the lateral force is F, the maximum pressure P on a roller in this bearing will be

$$P = \frac{Q + 2\,F\,tan.\,\alpha}{3\,sin.\,\alpha}.$$

From this value of P the diameter of the roller can be determined by the equation $P = K\,d^2$, the value of K, depending on the quality of the material in the ball, being kept sufficiently low to obtain a reasonable factor of safety. In this type of bearing where α is an acute angle the ratio $\frac{Q}{F}$ must be greater than $tan.\,\alpha$, else the shaft would run out of the bearing. When F is great compared with Q it is better to make $\alpha = 0$. The bearing then assumes the form shown in Fig. 7 which is mainly adapted for radial pressure. The speed ratio in this case is the same as in Fig. 6. If α is made 90 degrees the pure thrust bearing is obtained shown in Fig. 8, with one or more rollers on each stud; the speed ratio is 2:1 independent of the size and number of the rollers.

Fig. 9 shows a modification arranged for a high-speed shaft so as to balance the centrifugal forces acting on the rollers; for this purpose the angle β is made so that approximately

$$tan.\,\beta = \frac{P}{C},$$

P is the pressure on the roller and C the centrifugal force acting on it. Fig. 10 shows spherical rollers arranged in bearings of an electric motor with a certain amount of end play for the shaft.

Experiments by the Danish government with windmills for electric power generation for industrial and agricultural purposes have demonstrated that those of the four-wing type are the most successful in operation because they give the most power for a given area. With a wind velocity of 20 feet per second—13½ miles per hour—one horse-power may be developed on 65 square feet of surface. With a velocity of 26 feet the power is doubled.

Work of the Knight Drilling and Milling Machines

On page 648, Part 1, of Volume 30, we illustrated the combined drilling and milling machine built by the W. B. Knight Machinery Company, St. Louis, Mo., and we show herewith some of its applications which will give an idea concerning the various kinds of work for which it is adapted, and will show its adjustability, as well as some of the attachments and fixtures which can be used with it.

In Fig. 1 a plain table has been bolted to the top of the regular table, so as to present a smooth surface to allow jigs to be readily handled in plain drilling work. In Fig. 2 a chuck has been mounted on the table to hold a die block, which is being cut out by an end mill, and the table is tilted on its horizontal support so as to give the desired clearance for the die.

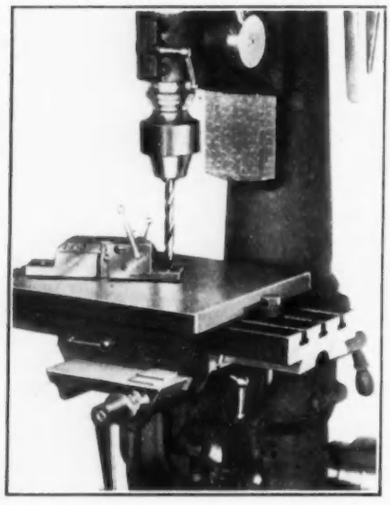


FIG. 1. USED FOR PLAIN DRILLING

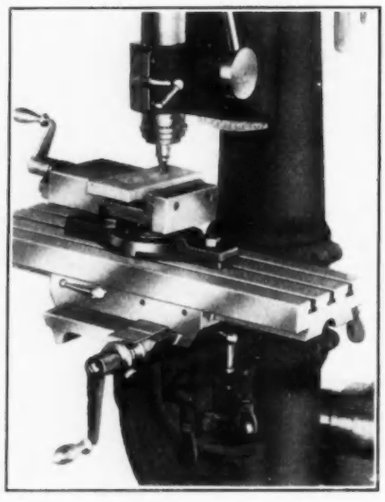


FIG. 2. MILLING A DIE BLOCK

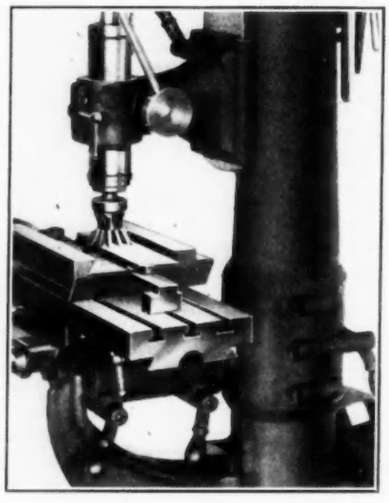


FIG. 3. MILLING A DOVETAIL SIDE

Fig. 3 shows another milling operation, this time a dovetail being undercut with the angular mill shown, and the work clamped directly to the table. This shows how the table and saddle are mounted on the horizontal cylindrical bearing so as to allow being inclined to any desired angle, and also shows how this bearing is supported to the column of the machine and at the outer end. Fig. 4 shows another die-block milling operation, this time being mounted on a circular chuck or attachment, so as to secure the desired radius for the opening in the die. In Fig. 5 the outboard bearing of the knee has been removed, the table tipped to an angle of about 45 degrees so as to enable the angular cut to be made.

In Fig. 6 the knee is swung into a vertical position so as to present the end of the work to the milling cutter and allow the work to be fed past it so as to cut the slot in the end. With the table in this same position, the shaft of bars of various lengths can be centered as a conical cup support is provided which slides on

the base of the column below the table, but is not shown in any of these views.

Fig. 7 shows the table again swung into its normal position, so that a slot can be cut in the top of the piece which is held in the vise. In Fig. 8 a simple indexing fixture is being used to enable the radial slot to be sawed in a gas burner by a saw held in the spindle, and in Fig. 9 a more elaborate indexing head is used, and spur gears can be cut in this way.

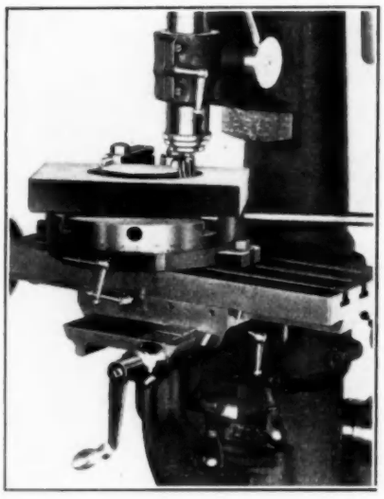


FIG. 4. CIRCULAR ATTACHMENT FOR CURVED SLOTS

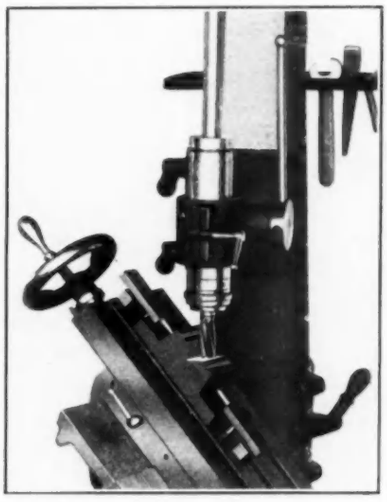


FIG. 5. TABLE INCLINED TO ALLOW VERTICAL MILLING

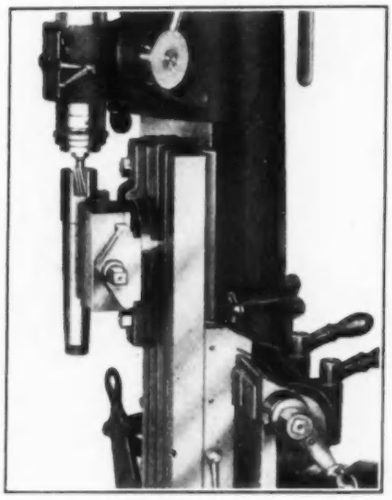


FIG. 6. TABLE SWING TO HOLD WORK VERTICALLY

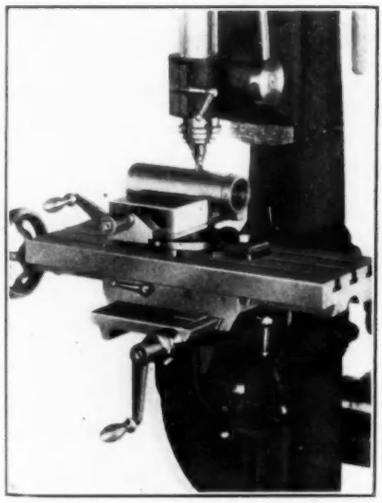


FIG. 7. CUTTING A SLOT IN A SLEEVE

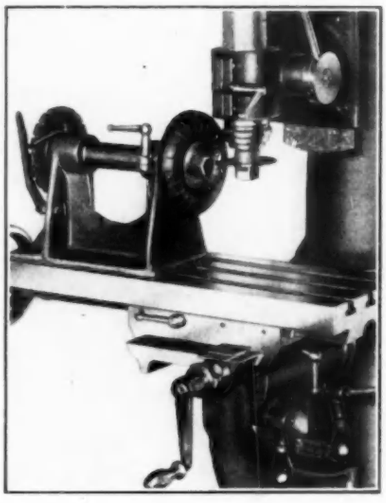


FIG. 8. SAWING A GAS BURNER

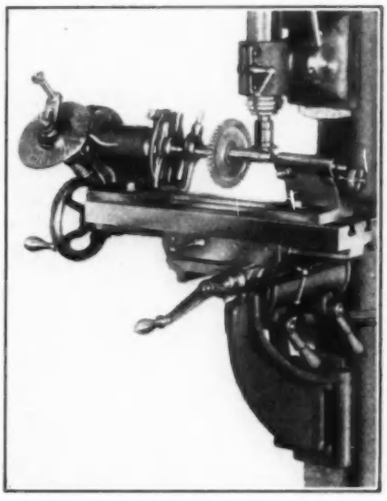


FIG. 9. CUTTING SPUR GEARS

For a jobbing or tool-making shop such a machine should find a very large field of usefulness, and many more applications will be found after such a machine is in actual use.

An interesting contest has been opened by the Chamber of Mines in which a prize of £1000 has been offered for the best drill produced up to January 1, 1909. The Transvaal Government has taken an active hand in the matter and will admit all drills entered for the competition free of duty and carrying charges.

Piston Rings of Uniform Strength

By W. Osborne

What would be the shape of a piston ring of uniform strength? Would it be a practical shape to make and to use?

"Don't you think that we could make some other shape ring that would be better than these?" The foreman of the testing floor was holding a piston ring in his hand and looking at it in a dissatisfied manner.

"It may be that they would be improved by a change in dimensions," said the Old Man. "What change would you suggest?"

"I don't know what change it would take to do it, but if they could be made so that they would bear with an even pressure all around they ought to come up quicker anyhow, and that would be a help."

"It would be interesting to know what shape a ring would need to be to give an even pressure on each part of it." The Old Man looked thoughtful as he began to think of the mathematical aspects of such a problem.

"Why wouldn't it be a good thing to make a ring that would spring evenly all around?" asked the foreman of the department where the rings are made. "I think that a lot of this trouble comes from springing the rings out of shape in putting them on the head."

"Would it be possible to figure out a shape for a ring that would give a round ring after a piece was cut out and it was sprung together without its having to be turned?" asked another foreman, who had been wanting to make sure that his work had nothing to do with the trouble. "A ring like that would save the cost of the extra turning."

The draftsman was called into the conference and asked if he could give the form that these rings would need to be.

"I am not very sure that I can figure it out, but if I can I am thinking that

you will have some awful-shaped rings. I don't think you would care to use them even if you could make them, and I think it would worry all of you to make them even if you did want to use them."

That did not sound very encouraging, coming, as it did, from the technical end of the establishment.

After a lot of talking, it was agreed that a ring which would under pressures, as indicated by the radial lines around the ring in Fig. 1, be round, would fill the first conditions; that is, it would bear equally hard on the cylinder at every point. As soon as this point was settled it was held by one man that the question then became the simple one of figuring out a uniformly-loaded beam with sections of equal strength at all points, but it was quickly pointed out by another that it was the resultant of a lot of forces acting at varying angles which had to be considered for each point.

The questions involved had aroused interest in many of the shop men who have not been mentioned, the fact being that almost every thinking man in the place was giving it some attention in his own way. Many of them did not get any farther than to find out some of the difficulties in the way, while a few, after thinking the matter over and looking at a ring from all points of view did not seem to be able to get any kind of a satisfactory grip on the subject.

One man asserted that he believed a ring which would sustain equal loads as indicated in Fig. 1, would also be round when the loads were removed and it expanded as shown in Fig. 2, but he could not back up his assertion by any demonstration.

Textbooks were hunted up, and all the technical authorities that were available were referred to, but nothing was found that seemed to fit the case. The only man who had received the advantages of a college education among the interested circle could not think of anything among his attainments which seemed to apply to it.

It having been pointed out that the resultant of the radial outward pressures in a pipe amounts to the diameter of the pipe multiplied by the pressure, and that in figuring on the sustaining power of a bearing the diameter is multiplied by the length to get the equivalent sustaining area, and it seemed reasonable to think that the lever arm of a split ring would be the diameter of the ring for the greatest length and for any point less than that it would be a chord drawn from the point to the open end.

The college man had forgotten how the formula for finding the bursting strain in a pipe, and the forces acting on a bearing were derived, but did not think that they would apply to the ring. He spent an evening applying his knowledge of the calculus to finding how it would work out for several points. The result of his work seemed to indicate that for the points which he had taken the chord would be the effective lever arm.

The man who found diagraming within his area of knowledge while the calculus was not, spent some of his time diagraming the forces and his conclusions were close enough to convince him of the same thing.

Acting on this he attempted to figure out the shape of a ring 8 inches in diameter and 5/8 inch thick opposite to the cut. The results which he obtained are not accurate for several reasons. In the first place he divided the ring into 24 equal spaces and assumed that the load, instead of being spread equally over each part of the ring, was also divided into 24 parts and one part acted on the center of each division. Besides that he found the length of the chords from a diagram. Past experience has proved to him that the results of diagraming, while generally close enough for practical purposes, are not as accurate as figuring done by a competent man. He prefers the diagraming because when it comes to figuring his chances of errors are more numerous than with the diagram, and not as easily discovered.

As a result of diagraming to get the effective lever arms for the different points, and of figuring to get sections as strong as the 3/8-inch section with an effective lever arm equal to the diameter at the different points, the dimensions shown in Fig. 3 were obtained.

The dotted line was made in an attempt to show how near to this a ring could be turned and be a circle on the inside.

If the dimensions given were correct then a ring made so as to be 3/16 inch thick at the point, 3/8 inch at the back and then the points filed somewhat thinner for about 30 degrees on each side of the cut would be very nearly right.

When it came to demonstrating anything about the shape of a ring that would have a uniform deflection in every part so as to be round when it was sprung into the cylinder without having been returned no progress was made. The opinion was advanced that a ring which would have equal strength in every part when the weight was evenly distributed as shown would also have equal deflection, but it was only an opinion, even though it seemed a plausible one. It was readily understood that when a beam of uniform section is loaded so that it shows a deflection it does not take the form of the arc of a circle, but that of an irregular curve whose curvature is greater the farther one gets from the unsupported end, but a way could not be found to apply the rules for deflection to an irregular-shaped beam.

When one considers the numerous joints which have been devised for rings, and the shapes and sizes which are in use it would seem reasonable to suppose that the subject of the best thickness has also received scientific consideration, but if it has been the results have not been widely known to the men who have to make the rings.

I hope that this description, with the help of the drawings, will be clear enough to enable those who are interested in such things to understand how the attempt was made to solve the problem.

Nothing has been said about the width of the ring because the usual, and so far as my information goes, the only practice is to make them of a uniform width

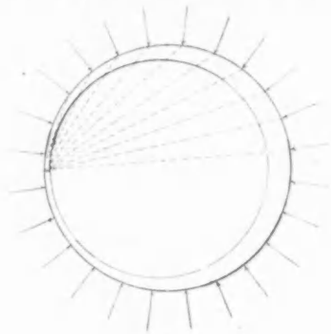


FIG. 1

FIG. 2

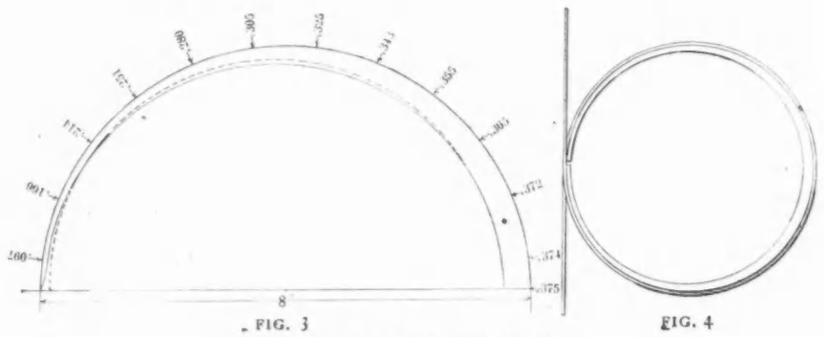


FIG. 3

FIG. 4

PISTON RINGS OF UNIFORM STRENGTH

when the ring has to supply the pressure to make the fit against the cylinder. This being so, the width does not need to be considered unless it were desired to design a ring which would support a given load with a certain deflection. In such a case it would be necessary to have the width so as to calculate for the thickness or else have the thickness as a starting ing point and calculate for the width.

The material considered is cast iron.

There is another thing which I should like the opinion of others on. Supposing that a ring has been made which it is thought may be of such a section as to have a uniform deflection, and a piece has been cut out of the thin side, and a wire passed around the ring and tightened so as to bring the ends of the ring nearly together, the ends of the wire to leave the ring at tangents to the cut, will this wire exert a uniform pressure all around on the ring? Fig. 4 will show the idea.

Some Features of a Crank-Grinding Machine

By E. A. Shriver

Grinding the bearings and cheeks of crank-shafts, especially when the bearings are short, is an operation where the automatic traverse movement of the grinding wheel is not advisable, and this movement is required to be made by hand power. The movement is so slight at times that the mechanism for obtaining it must be geared so as to avoid any sudden jump that the grinding-wheel carriage might make when traversed on its guides by hand. Fig. 1 shows the hand-wheel mechanism of the Landis crank-grinding machine, and it will be clearly seen that the small hand wheel at the top is the one used when traversing the wheel carriage in grinding short bearings on cranks. This small hand wheel is geared to the main one with a reduction of 11 to 1, and its position at the top enables the operator to be always close to his work.

In Fig. 2, which is a cross section of the mechanism, the manner of disengaging the small, slow motion hand-wheel pinion is shown. When the pinion shaft is pulled up enough to allow the small plunger, which has a coiled spring behind it, to slip into the lower groove in the shaft, it is then held at this point and the main hand wheel can be used as on any other Landis grinder.

This small wheel can also be pulled entirely from its bearing and laid aside, thus eliminating any inconvenience that it might cause the operator when grinding any regular straight or tapered cylindrical work. Another important feature for a crank-grinding machine is shown in Fig. 3. This is a truing device with a gage attached. The fillets of the shafts should be ground by a correctly shaped wheel and should also be accurate as to size. A fixture to true the grinding wheel properly for grinding any size fillet that may be required is a necessity then to the successful grinding of this class of work.

With the fixture shown any radius from ⅛ to ½ inch can be obtained. The small bracket clamped to the right-hand side of the fixture is graduated and carries a gage which is shaped like the letter L. The gage is set at the required radius, and the diamond which has a screw adjustment is moved out to meet the gage and is then fastened with a lock nut. Fig. 3 shows this fixture and the stationary back rest upon which it is clamped when being used.

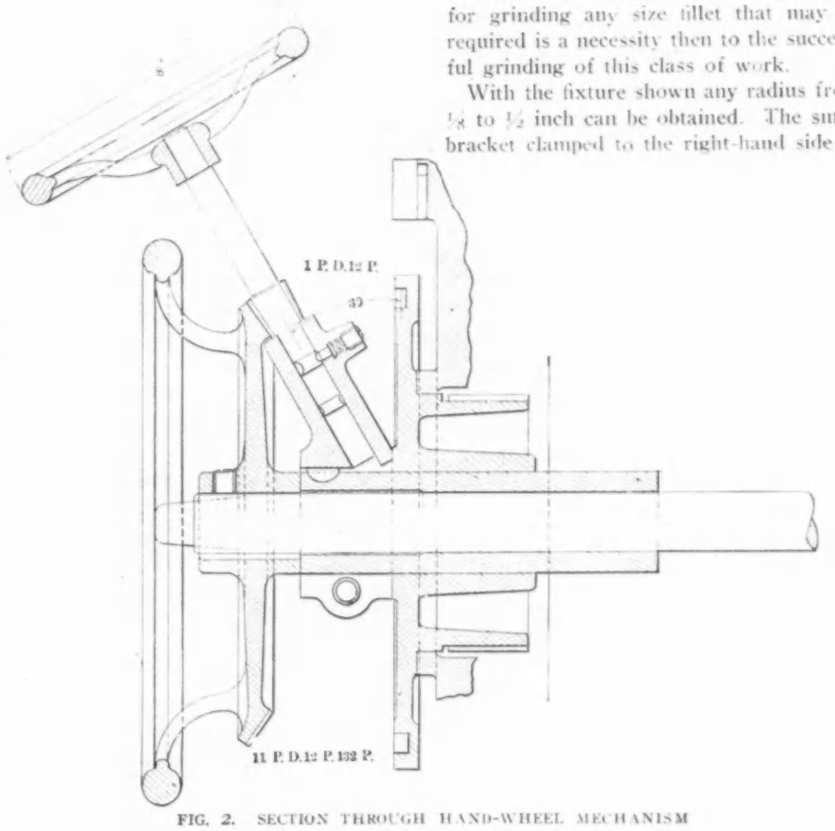


FIG. 2. SECTION THROUGH HAND-WHEEL MECHANISM

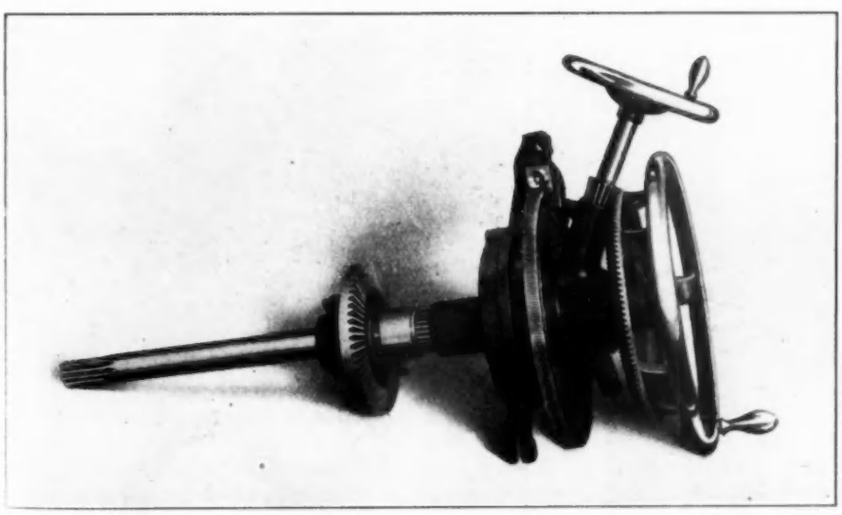


FIG. 1. HAND-WHEEL MECHANISM OF LANDIS CRANK-GRINDING MACHINE

FIG. 3. WHEEL-TRUING DEVICE CLAMPED ON REST

Automatic Lathe Arranged for Machining Cone Pulleys

The accompanying engravings show the Fay automatic lathe arranged for machining cone pulleys. After the hole is finished the pulley is mounted upon a hardened and ground arbor, the footstock end running in a bearing, which is provided with a ball thrust to take the end pressure, and the pulley being driven by pins fitted into an equalizing driving disk mounted upon the lathe spindle.

The tools used for squaring, turning and crowning the cone steps are supported in a block mounted upon the lathe carriage, this block being provided with cored holes, one for each step, and a distance apart corresponding to the width of the cone step. It is also provided with suitable clamping and adjusting devices so that each tool can be inserted, removed or adjusted independently. The arms upon the back shaft also carry tools used for squaring the ends of the pulley and in the pulley illustrated, the largest step being wider than the others; this extra width is finished with the back tools. The machine is, of course, provided with suitable formers and cams, and in operation it first squares down the edges of the cone steps, and when the proper depth is reached the tools feed toward the footstock, turning all the steps, either straight or crowning, as determined by the shape of the former used. During the time the front tools are in operation, the back tools complete the squaring of the ends and the turning of the surplus width of the largest cone. In manufacturing it is advisable to rough a quantity of the pulleys in this manner, then replace in the lathe and repeat these operations taking a light cut over all of the surfaces. The machine can also be arranged to take the undercut for belt clearance on the sides of the cone steps if desired. While it is feasible to use for this work a swiveling tool-post holder, mounted upon the lathe carriage and long enough to contain several tools, the tool holder here illustrated is considered preferable as it can be made in any machine shop and adapted to the work to be machined. It is stated that in machining a five-step cone pulley like the one shown in the machine with steps measuring from 109/16 to 5¼ inches diameter by 2½ inches wide, the roughing cut was taken in 25 minutes and the finishing cut in 20 minutes, including the time of putting in the work and removing it from the machine. The builder is the Fay Machine Tool Company, Philadelphia, Penn.

Filing the American Machinist

By Wm. C. McLeod

The accompanying photo will illustrate a method of filing American Machinists

BOX FOR FILING THE AMERICAN MACHINIST

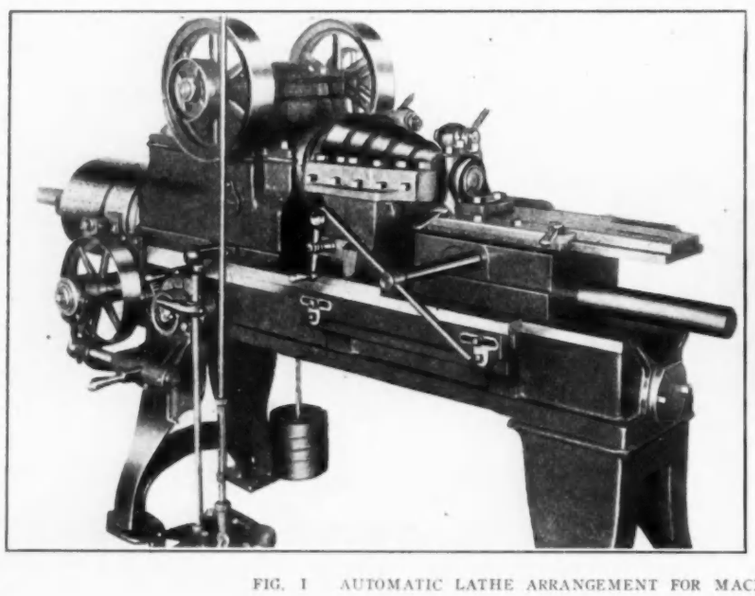
that I have found very satisfactory and convenient, and it may prove of interest to other readers.

It employs the vertical-file system now used in all modern offices and it is cheap, compact and capable of indefinite expansion. A box of the size shown, 9½x12½x30 inches inside, will be good for eight or ten volumes with the advertising pages torn out. A second or third box can readily be added. The inclined back board is moved along from year to year, and held in place by two small pins, engaging with the holes in the sides and a steady pin in the bottom. In the purchased files, this is a mechanical device which can be adjusted to any point down to 1/16 of an inch. Three inches between the pin holes is just about enough to accommodate one year's numbers.

The heading cards divide the volumes by years, and intermediate cards into months and pages, if wanted. I prefer to have the indexes all in one section, as this is more convenient in looking up any given subject. One can quickly glance through the contents of a number of years without having a lot of cumbersome books to handle, and the article when found is in a pamphlet of a few pages and, therefore, very convenient for reference. The box can be anything from plain pine, that anyone can make, to one of elaborately finished hard wood, constructed by the office-supply people.

It might seem that the numbers would not stand up, but if the wire staples are put back in when the reading matter is taken out and the back board properly adjusted, there is sufficient stiffness in the books to keep them up nicely.

In Italy a number of curious boats have been built of reinforced concrete, the frames being first so built, and then given an inside and outside covering of concrete, reinforced with wire netting. Watertight compartments are thus formed between the two layers of concrete. The outside is finished with pure cement, giving a very smooth surface. It is claimed for these boats that they can be built very easily and cheaply, that they are strong and cost little for maintenance, and that they are fireproof.



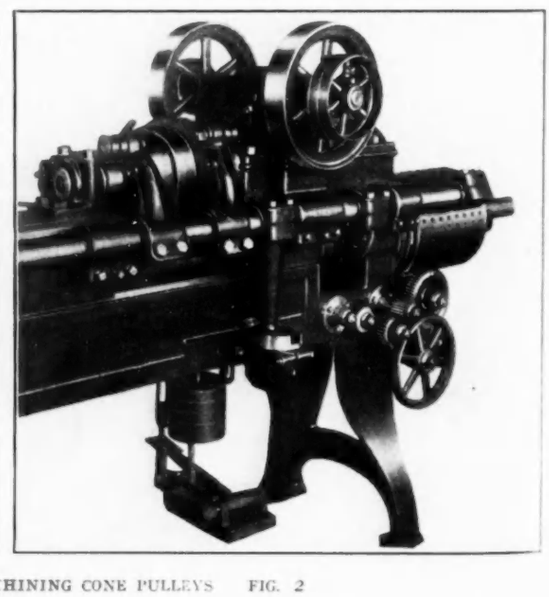


FIG. 1 AUTOMATIC LATHE ARRANGEMENT FOR MACHINING CONE PULLEYS FIG. 2

Practical Letters From Our Readers

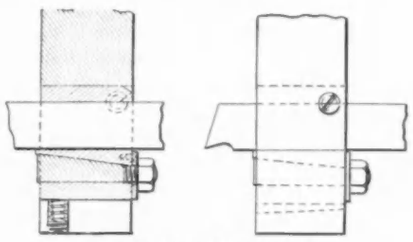
A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

Slotting-bar Tool Box

The accompanying sketch shows a slotting bar for general work.

The bar which was first fitted was 2¾ inches square, but there is no reason why a round bar may not be used if desired, and the proportions can be arranged to suit larger or smaller bars.



SLOTTING-BAR TOOL BOX

The tools were made of 1x1½-inch steel, and can be used above or below the wedges, as required.

Rugby, England. OSWALD B. DAVIES.

A Gage for Rod Ends

Fig. 1 shows a gage of special design which was made for a small ¼-inch rod that had to be a certain radius on one end and a certain taper point on the other, both operations being performed on a

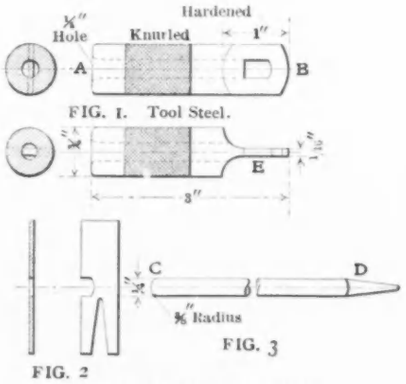


FIG. 1. Tool Steel.

FIG. 3

FIG. 2

A GAGE FOR ROD ENDS

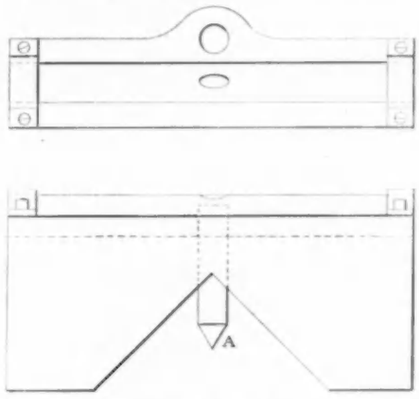
screw machine. This form of gage is much better than the old style sheet-metal gage, as shown in Fig. 2, as with such a gage it is almost impossible to tell at a glance when you have the proper radius, or taper, because with the round surface of Fig. 3 the operator is more apt to tilt the rod one way or the other.

The gage shown in Fig. 1 holds the rod when inserted in *A* perfectly square with the form wanted at *B*, also at *C* and *D*, Fig. 3. When a gage of this style is made for point *D*, Fig. 3, the flat *E*, Fig. 1, will have to be milled back farther to show the whole form. Having several jobs like Fig. 3 with different-styled ends, we use this form of gage entirely and find it very satisfactory.

Lowell, Mass. J. S. SCOTT.

A Handy V-Block and a Triangle

A handy tool for setting up turned work for drilling, etc., can be made from a small V-block and level, as shown. The V-block is accurately drilled square and central with the V and the hole fitted with a sliding center. The level is fixed to the base of the block as shown. When a col-



THE V-BLOCK

lar or shaft is to be slotted or drilled, the setting up is usually done by means of a surface gage or scribing block and this operation takes some time, whereas with the tool sketched, the center of the required hole or slot is located by the point *A*, the V-block pressed home on the shaft, and the whole lot rotated until the required position is obtained, when the level will show horizontal and the job can be clamped up.

Another wrinkle is for the draftsman. Small triangles can be bought with the right angle divided into degrees, but these are usually too small to be of much use. A better plan is to mark off the edge opposite the 60-degree angle of a 10-inch triangle, with a tangent scale on a 10-inch base line. It is thus possible to set out any angle with a degree of accuracy quite sufficient for all ordinary drawing purposes without looking up tables of tangents or chords, or borrowing a protractor from the office boy.

Albany, N. Y. ALFRED H. STORK.

Parallels for Chucking

Knowing the readers of this paper have some time had work to do in a lathe chuck, such as squaring up work when the piece is thinner than the jaws of the chuck, they will look for a piece to put back of it to save time in truing it up; the easiest way I have found is

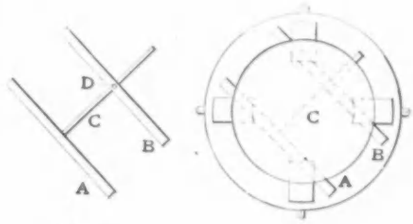


FIG. 1 FIG. 2

PARALLELS FOR CHUCKING

to take two pieces of rod *A B*, make them the length of the diameter of the piece, then take a piece of wire *C*, one-half the diameter of the other piece, then drill a hole in the center of the pieces *A B*, making one a driving fit and the other a sliding fit; now drill a hole for a set screw *D*. Drive the wire *C* into one piece and have the other to slide up and down to fit different size pieces, and put a set screw in to hold it. A tool like this saves a lot of time. Fig. 2 shows the rig in place. C. E. TANNER.

Providence, R. I.

Facing and Threading a Dust Cap in the Hand Turret

Fig. 1 shows the steel blanks as they came from the press and Fig. 2 shows the

FIG. 1 FIG. 2

THE WORK

finished piece. The manner in which they rigged up to do these was very clever and speedy. The operations were drill, square the edge and tap. Drilling and squaring were done at the same time with a combination tool. The tap was held in a regular releasing holder. The blanks were held in a drawback spring collet closed by a handle at the rear end of the spindle. Inside of the collet was

put a spring ejector which, when the chuck was opened, threw out the finished piece. Inside of the spring was a stop. There were six holes in the turret. In the first hole in the turret was put a hollow split plug with a slight taper which fitted the hole in the blanks. In the second hole was put the combination drill and squaring tool and in the third hole were put the tap and holder. In the other three holes was put a duplicate set of tools in the same order.

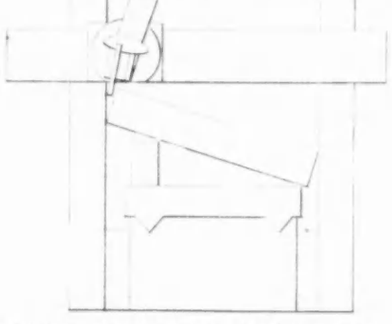
The order of operations was as follows: A blank was put on the plug and the turret revolved and the blank thrust inside of the chuck against stop, the chuck was closed, the plug withdrawn and the turret revolved to drill; while drilling the operator put a blank on the second plug. After drilling and squaring the turret was revolved and the piece tapped, the chuck was opened while the turret was revolved to the plug with a blank all ready to put in chuck.

An operation on piece work would average 400 per hour.

Worcester, Mass. PAUL W. ABBOTT.

Planing Castings Too Wide for the Planer

When I was running a planer for the F. H. C. Company a few years ago they took in a job of planing some base plates that were supposed to be six feet wide when finished. The planer was six feet and two inches between uprights, so we felt pretty safe. When the castings came they proved to be six feet and three inches wide. The owner was sent for to see what the trouble was. He was completely non-plussed at first, but finally got a little light on the subject. "I guess," he said, "that they wanted to plane these castings at the foundry. They have a planer large enough to do it, but my foreman, Jim, was bound to have me send them over here, because he thought they could not do a good enough job. Now they wanted to fix the thing so you could not do it."



PLANING CASTINGS TOO WIDE FOR THE PLANER

That set me right up on edge, for I never liked to get stuck on a job and I was bound to plane those bases. I did it in the way the figure shows; just tipped them up a foot or 18 inches and planed down one edge till they would go between the housings. The owner paid for the job by the hour, so we got out of it all right, and he knew where to charge up the extra time if he wanted to. The rest of the bases came about right for width.

Of course, I laid the bases down flat on the table to finish them after I got them narrow enough.

Fitchburg, Mass. CON WISE.

Milling Nuts and Cutting Key Seats

Fig. 1 shows an example of work done on a modern quick-change miller in milling a hexagon nut, while Fig. 2 shows the method of cutting four key seats in a shaft equally spaced. It will be noted that the indexing feature in the chuck makes it very convenient for milling hexagons or squares, as there are 24 stops in the index. The feed levers in the illustration engage the pinion and slide. In one position the pinions are free to be moved, in a second position the levers are disengaged from their pinions and may be instantly swung to a new position.

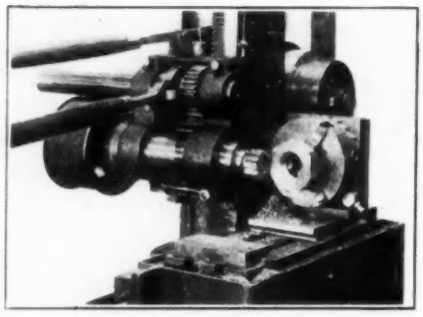


FIG. 1. MILLING HEX NUTS

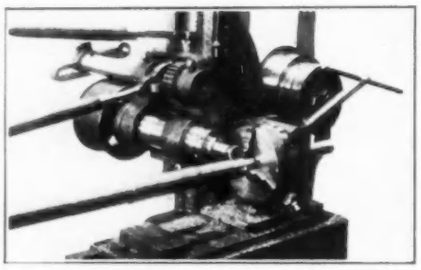


FIG. 2. CUTTING FOUR KEYSEATS

A movement of the lever at right angles to the direction that moves the slide locks the slide and disengages the lever from the pinion so the lever may be swung to a new position.

The three-jawed chuck shown in the illustration is 6 inches in diameter and has two sets of jaws taking through the center 1 9/16 inches, as indicated in Fig. 2. The chuck is mounted on a heavy angle plate, which is secured to the index plate and can be set in vertical and horizontal positions.

The 24 stops or graduations on the chuck index are very convenient in spacing cutters, laying out key ways on quarters or opposite sides of a shaft, or for milling square or hexagon heads while the chuck is also very convenient for circular milling.

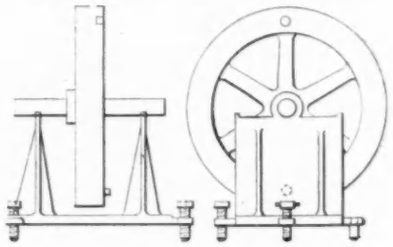
Buffalo, N. Y. F. C. P.

Magnetized Balancing Weights

I have been quite interested in the shop kinks that have recently appeared and perhaps this method of balancing flywheels will be new to some of your readers as I have never seen it used before. We make a great many gas-engine flywheels about two feet in diameter, weighing about one hundred pounds and finished on both sides and the face of the rim. The variation in the spokes and the inaccuracy in chucking the hole central with the inside of the rim causes them to be anywhere from one ounce to a half pound heavier on one side than on the other.

It had been our practice, as the rim is about two and one-half inches deep, to balance them by placing an arbor through the hole and then setting the wheel on balancing ways which had been carefully leveled. The workman by marking the side of the rim that turned to the bottom with a piece of chalk could see which side was heavy and would drill about a 13/16-inch hole in that side of the rim to a depth regulated by his judgment and the speed at which the wheel would turn on the ways when out of balance. This was a rather uncertain way and sometimes the hole was drilled too deep, requiring another one on the opposite side.

To make the method more positive of being right at the first trial we took five pieces of 13/16-inch round tool steel 1/4, 1/2, 3/4 and 1 inch long, respectively, and hardened them by dipping and not drawing at all. These were then placed on the magnetic chuck on the surface grinder and one end ground perfectly flat, at the same time they became thoroughly magnetized. These are used as weights when balancing. They can be placed on the side of the rim of the wheel until the wheel will just balance and then



MAGNETIZED BALANCING WEIGHTS

by measuring their length, the depth of the hole in the rim can be determined at the first trial. The accompanying illustration shows their use.

Detroit, Mich. M. B. H.

A Water-tight Joint for Sheet Metal

It is not always an easy job to make a good water-tight right-angle joint of sheet

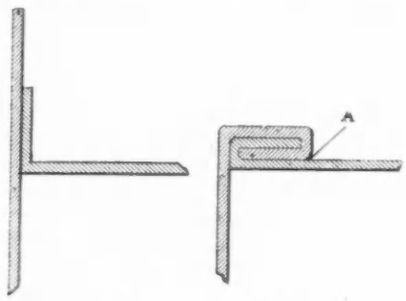


FIG. 1 FIG. 2

A WATERTIGHT JOINT

metals such as copper, tin or brass. It often requires quite a lot of time and solder to make one absolutely water tight.

Figs. 1 and 2 show a joint good for sheet metals up to 0.10 inch thickness, which is water tight without solder. Fig. 1 shows how the sheets are laid out and the step between Figs. 1 and 2 is obvious. Fig. 2 is enlarged somewhat and for thin metal the hump is not nearly so noticeable as shown.

Although as stated the joint is water tight without solder, yet for precaution and also to hold the joint rigid, solder is often run into the groove *A*.

Wilkinsburg, Penn. R. A. ANDERSON.

To Drill Hard Steel

Holes may be drilled (or relocated and bushed) in hardened-steel plates by the

FIG. 1

FIG. 2 FIG. 3

THE LAP AND THE SCRAP

following method: I use a hollow lap such as is shown in Fig. 1, made of soft steel, which is charged with powdered diamond, or in other words, the lap charges itself as it advances by constantly removing it from the work which allows the diamond to get in front of the lap for the next cut. The lap should be made as thin as is practical, which is governed by the work to be done.

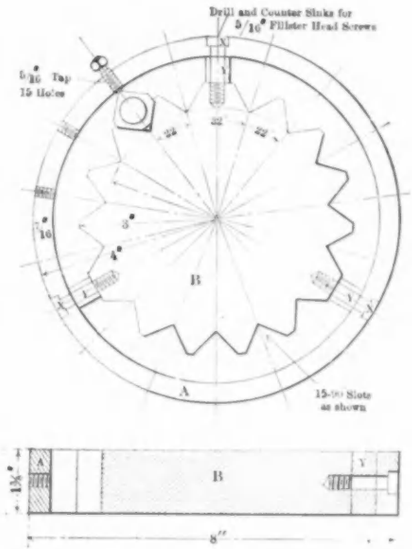
The work is properly located on the face plate and the lap used allowing a little to finish grind after the plug is cut out. This plug would look like Fig. 2. When the hole is to be relocated in the plate the piece removed will look like Fig. 3.

This is not a slow process, and is away ahead of hardening drills in mercury and then not being able to do the job.

Waltham, Mass. S. W. GREEN.

Fixture for Holding Square Pieces

Not long ago we were confronted with the problem of holding some small square trunnion blocks on the magnetic surface grinder, the required operation being to grind off the ends of the blocks at exactly right angles to the sides.



FIXTURE FOR HOLDING SQUARE PIECES

The fixture shown herewith was designed for the purpose and it does the job admirably.

The outer ring *A*, in which the set screws are placed which hold the pieces, is fastened to the inner piece as shown with fillister head screws and distance pieces *X X X*.

The inner notched part *B* holds the pieces square with the grinding face. The fixture is filled with the pieces and placed on the revolving table of the magnetic grinder and fifteen pieces are ground at each setting.

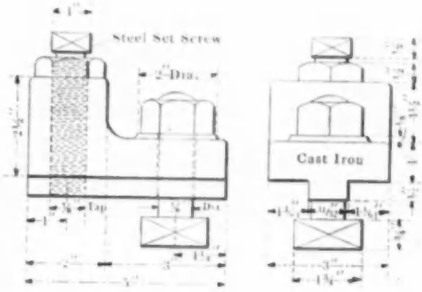
All the parts should be made of machine steel. I am sure this little device will be found very useful in many ways and the foreman who ever has this same problem presented to him will be sure to appreciate its use. TOOL DESIGNER.

Flint, Mich.

Adjustable Blocking

The illustration shows an adjustable block which was gotten up for work on the table of a Bullard boring mill.

There are four of these which slide in the T-slots between the jaws. We have found these very useful as by using longer set-screws they can be used on quite a number of jobs and save making



ADJUSTABLE BLOCKS FOR BULLARD BORING MILL

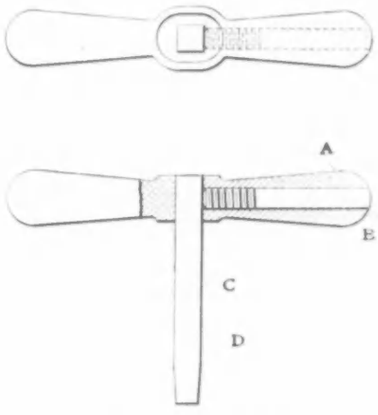
an expensive jig when we have not a large number of pieces of the same kind to do.

WM. CASEY.

Kingston, Ontario, Canada.

Drill Chuck Key Wrench

The handle *A* is made of machinery steel, and is strong enough to stand the blow of a wrench, hammer, or any other weapon a fellow may find handy to strike it, when his drill will not hold. If he does happen to break key *C*, it is a small matter to grind a new point to fit or have it reforged by simply releasing screw *B*.



DRILL CHUCK KEY WRENCH

Another great advantage is that key *C* is made from a piece of square screw-driver steel, which will stand a greater strain than any ordinary round stock, which keys for this purpose are usually made from.

This may seem to the reader a thing of very little importance, yet if he will take

time to observe chucks and keys in the different shops he will invariably find keys unfit for use, with handles bent and points rounded, which is very injurious to the chuck screw.

Franklin, Penn. B. M. WELLER.

Saving a Crankshaft

We had a crankshaft turned 0.015 inch below size at *A*, Fig. 1, the distance shown 4¼ inches on end of shaft being a gear fit. Our practice is to allow a press fit for all gears, and this shaft being for a repair job and not supplying the gear, we seemed to be up against it, as the pins had been finished and the end squared off to length. As it was not possible to upset the shaft at the point shown, and maintain the length, we had to find some other way of doing it.

One suggested boring a hole in the shaft, as shown in Fig. 2, and shrink a plug in it that would drive in; this seemed to be a way out of the trouble. Calculating the strength of the shaft and the size hole we could bore without sacrificing too much strength, I found that we could bore a 1¼-inch hole and still have enough strength. I had a piece of stock made up with the same sizes as the spoilt shaft and a hole bored 1 inch diameter and 6 inches long, and a plug turned to allow a drive fit in after the piece had been heated and expanded, but after driving the plug and letting it cool, there was very little expansion at *A*, Fig. 2.

Finding that we did not get the result looked for, but believing that we could save the shaft, I next had another test piece turned up and had a hole drilled in and reamed with a taper reamer (¾-inch taper to the foot) which made the section through *A*, Fig. 2, of a greater area than that at *C*, Fig. 2. I then had a swedge made, as in Fig. 3, had the blacksmith heat up the test piece and drive it to the bottom of the hole. The result was that we expanded the piece at *A*, Fig. 2, to 3.577 inches, which allowed us enough stock to finish it up to the required size

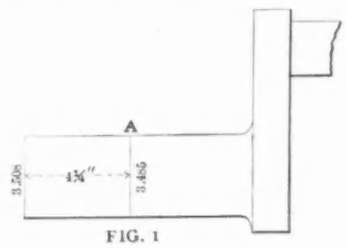


FIG. 1

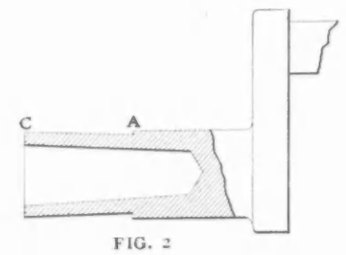


FIG. 2

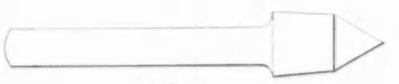


FIG. 3

and without shortening the length, as was ascertained by testing before and after the operation. We were then ready to go ahead on the shaft, and, by exercising great care in handling the partly finished shaft, in heating and swedging, we were able to finish up the shaft to the standard size.

After this operation was finished we rebored the hole and pressed in a straight plug before finishing up the shaft and when completed it could not be detected.

Springfield, Mass. R. D. REDINS.

Fixture for Milling an Automobile Spring Seat

The prime necessities for securing satisfactory results when doing work on a milling machine are first, firmness in the working parts of the machine, and second, a good, sharp cutter.

Hardly less essential, however, is the proper holding of the work which is to be machined. However well the machine may be made, if the work springs in the vise or fixture which supports it, the result will surely be disappointing. Pieces of irregular shape, especially castings which vary in their size and are not self-supporting, demand fixtures which will adapt themselves to the work with a considerable amount of freedom.

In the accompanying illustration is shown a fixture for holding a spring seat for an automobile. This spring seat, which is comparatively light in its design, presents a broad upper surface which is to be milled with a form cutter. It is a drop forging and is made of extremely tough steel.

The fixture, Fig. 1, is composed of a suitably designed cast-iron frame which is provided with a tongue *A* to fit in the slot in the table of the milling machine, a slot *B* and two holes *C C* for the bolts to hold it.

The frame holds a steel stud *D* on which the spring seat is mounted, and on which the U-washer *E* and the nut *F* are used. In the frame are also four

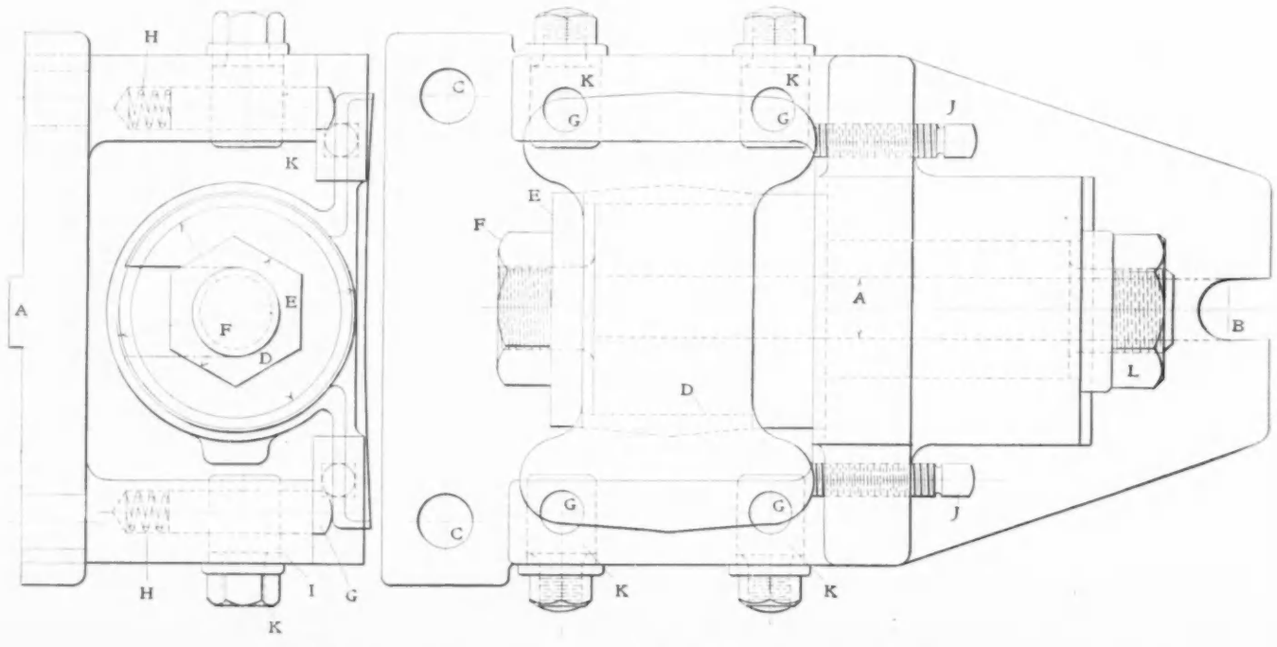


FIG. 1. FIXTURE FOR HOLDING AUTOMOBILE SPRING SEATS WHILE MILLING

jack-pins *G*, the springs *H*, the binders *I* and the set-screws *J*.

Before the spring seat is sent to the milling machine, the hole in the hub is bored and the ends of the hub are faced off. The main stud *D* in the fixture is turned to suit the hole in the hub, and is firmly held in a boss on the frame by the nut *L*.

When a spring seat is to be milled it will be put on the stud *D* by slipping it over the nut *F*, this nut being smaller than the hole in the hub. The U-washer *E* is then put on the small shoulder at the end of the stud *D*, and the nut is tightened against the washer, thus holding the work.

This type of washer permits the work to be put on and taken off with but a single turn of the clamping nut *F*, while a standard washer would require the removal of the nut for each piece which was milled. After the work has been clamped in position by the nut *F*, the jack-pins *G* are released and pressed against the extending wings of the spring seat by the springs *H*.

The springs are not strong enough to displace or distort the work, but will adjust themselves to any variations in the forgings, and, when clamped, will hold against any pressure the cutter may create upon them. After the pins are locked, the set-screws *J* are made to bear against the work to resist the thrust of the cutter.

In this condition the piece, which is in itself so non-resisting, is thoroughly supported on all sides and "takes a good cut." This result was never obtained when only holding it by its own hub.

The frame itself is heavy. Its proportions may be seen when it is known that the hole in the hub of the work is 2½ inches in diameter.

HERBERT C. BARNES.

Hartford, Conn.

A Drill Jig for Piston Rings

In the fitting of the rings in the pistons of gas and gasolene engines, the usual

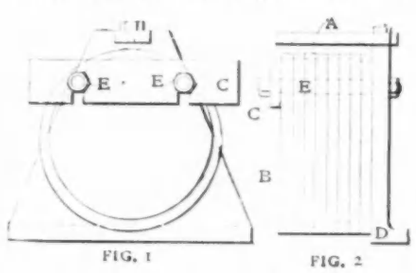


FIG. 1 FIG. 2

DRILL JIG FOR PISTON RINGS

practice is to secure them from turning round by placing a pin in the ring groove and cutting out the ring so that it will slip over it.

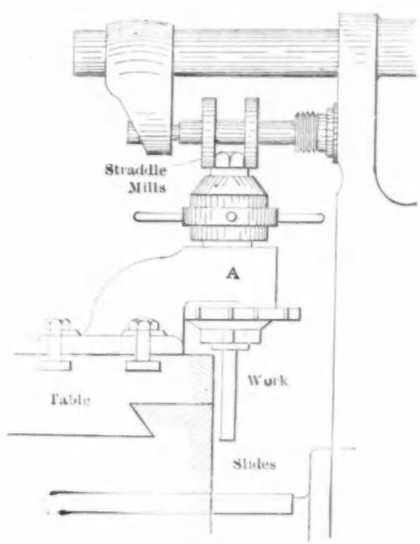
I believe one of the best ways to do this job is to drill the hole to receive the pin half in the ring groove and half in the lands between the grooves, or in other words, the center of the pin hole in the piston is located on the edge of the ring groove. The snap ring could then be cut out as herewith described.

A fixture as shown in Fig. 1 was made, and the job done on the drill press. The rings *B* were strung along on two pins *E*, which were fastened on the angle plate *D*. The plate *C* clamps the rings together and holds them securely while drilling by tightening the nuts on *E*. The hardened-steel plate *A* acts as a guide or bushings for the drill. The holes are so located in this drill guide that their centers are on the line between two adjacent rings. The angle plate *D* is bolted to the drill table. In boring one hole the necessary operation is performed on two rings.

Toronto, Ont. FRANK E. BOOTH.

Vertical Index - Milling Fixture

The accompanying drawing shows an index-milling fixture. It was designed



VERTICAL INDEX FIXTURE

mainly for holding long work such as long hexagon or square-headed bolts and screws to be operated upon when held vertically. As will be seen from Fig. 1, the fixture is held on the milling-machine table with the main portion of the fixture overhanging the side of the table so that pieces of work longer than the hight of the fixture can project right through the hollow spindle clear of the table. Usually long work of this description is operated upon when held horizontally, but straddle mills cannot always be conveniently employed when the work is held in this position, that is, without laboriously vertically traversing the table up and down. Of course, ordinary bolts could be milled easily enough, but not so if the work had a collar adjacent to the milled portion. It may not be a good feature for the fixture to overhang the table, but otherwise to accommodate the same work it would have to be made very high for the work to clear, and again a vertical fixture is adaptable to a greater range of work than a horizontal one. When used for short work, it can be clamped to the middle of the table.

The arrangement consists of a cast-iron body *A*, the base with tongue machined to fit the milling-machine table upon which it is firmly held by three bolts, and bored out to receive the hollow spindle. This spindle is made from a mild-steel forging, one end being machined to carry the index plate, the other end bored out for locating the spring collets, and screwed on the outside to suit the cap operating the collets.

The cap is of mild steel, case-hardened, and is ground on the plain bearing portions and on the internal conical part. The index plates are of cast iron and are held in position on the spindle by two keys and lock nut shown. Indexing is accomplished by cam and plunger. A guard, not shown, was provided to prevent the cuttings getting into the working parts and to drain the lubricant back to the machine table.

Sheffield, England. J. C. HAFNER.

A Tapping Device

Quite some time ago I came across a novel tapping device which I think may prove useful to many, as a reversing machine is unnecessary as far as the principle is applicable. Referring to Fig. 1, the shank of the tap is the diameter of the bottom of the thread, so that the tap can pass through the tapped hole. The end of the shank is cut away for a short distance to a D-section, with a left-hand spiral of about 2-inch lead, the tap being a 3/16-inch Whitworth in the instance noted. The tap is driven by means of a shell chuck, Fig. 2, which is bored an easy fit for the tap shank. Pinned in the back of the chuck is a piece *A* similarly shaped to the tap shank. When the tap is inserted the end engages with the pinned piece, and the thread comes close up to the front of the chuck, the distance be-

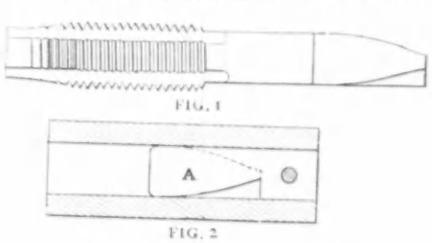


FIG. 1

FIG. 2

THE TAP AND THE DRIVER

tween the same being less than the thickness of the material being tapped. In operation the chuck is caught in a lathe chuck and the lathe started up. The tap is inserted and the hole to be tapped presented to the tap, the tap cutting the thread and being kept in the chuck by the

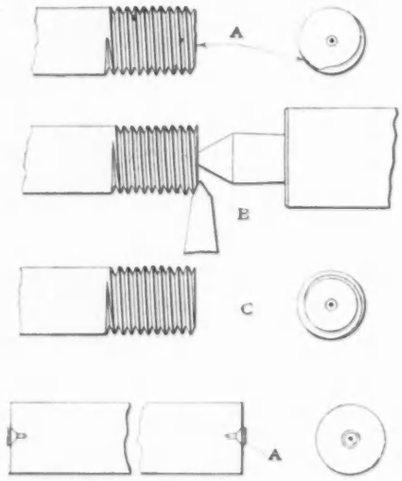
pressure of the work until the work comes in contact with the chuck when the tap runs out, by reason of the left-hand spiral drive, through the hole ready for replacing in the chuck. This device was used for tapping 3/16-inch Whitworth holes in bars 3/16 inch thick, and the time made on them was surprising. W. M.

London, England.

Small Details Often Overlooked

In the various operations of machining, fitting and assembling of machinery and tools, too often little details in method and finish are overlooked; resulting in a finished article which is defective in operation, and unsightly to the truly mechanical trained eye. Had there been a care, forethought or possibly knowledge of proper methods on the part of the workman, a neater and superior machine or tool at less cost would have been the result.

Were the little omissions to which I intend to refer here confined to the novice, it would be hardly worth while to mention them, but past experience has proved that the middle-aged journeyman is often as great a sinner in this respect as the apprentice. It sometimes happens that those placed in charge, through lack of shop training, are not able to see small defects or judge their importance.



FIGS. 1 AND 2. FINISHING THE ENDS OF WORK

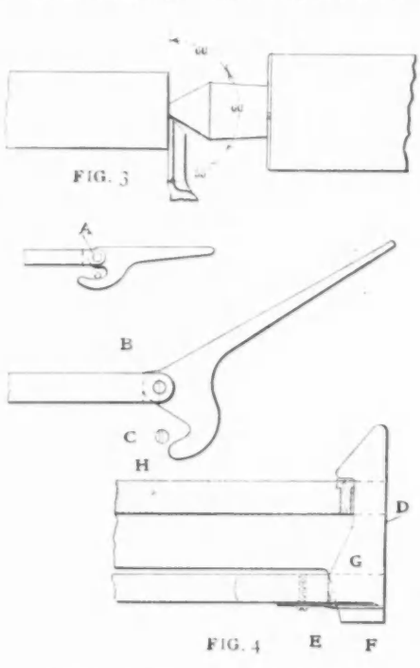
Notice the first thread on the screw shown at *A* Fig. 1. This is the way many so called lathe hands turn the job over to the bench hand to finish with a file.

After the thread has been cut to size, before removing the tool or work from the lathe, open the lead-screw nut, move the carriage by hand and chamfer as shown at *B*, leaving it finished as shown at *C*. This not only looks better but is better, and takes less time. The same method applies to the threading of a nut on the lathe. The above does not apply to harvesting machinery but to tool work where accuracy usually is economy.

To have the lathe boss bring you a shaft like this with the centers as shown at *A* Fig. 2, is exasperating. And on protesting at his not having them faced off to have him tell the bench hand to file "em" off, because "Bill haint got any cutaway centers fer his lathe and can't face 'em out!" If there are any more like this tell them to back the tailstock center a little, and they can face off the end clear into the countersink without a cutaway center.

Obviously great-grandfather was aware of those little kinks, and no doubt some who have actually learned their trade will smile when reading things so elementary; but the fact remains that there are plenty of men running lathes that have not learned them yet.

Now by looking at Fig. 3 it must be apparent to most anyone that 55 degrees is about the proper angle to grind a facing tool. This gives ample strength and permits facing close to the center without interfering. Take a look around the shop and see how many facing tools you will find on the tool-boards ground this way. Another common error is found in the jig latch, rounded as shown at *A* Fig. 4. If made as shown at *B* so the corner will not permit a movement greater than is necessary for the hook or cam to clear pin *C*, it will greatly facilitate the opening of the jig and have a tendency to prevent the use of profanity on the part of the operator; for as he lifts the latch, the moment pin *C* is cleared the leaf opens up with a continuation of the same movement without jamming his fingers.



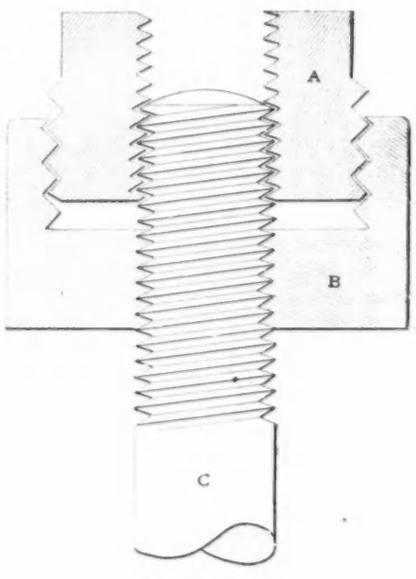
SMALL DETAILS OFTEN OVERLOOKED

The same principle applies to the form of latch shown at *D*; where if the corner *E* is rounded the latch is likely to be opened too far and spring *F* broken, and if corner *G* is rounded also the latch will fall in too far and not permit closing: Either case is annoying and unprofitable. It is well to remember if pin *C* is placed slightly out of line with the pin in the leaf, as shown by dotted lines *H*, the tendency to open from pressure on the leaf by the thrust of the drill will not be so great. Reverse the angle for form of latch shown at *D*.

Chicago, Ill. R. D. MORSE.

A Lock Nut That Does not Pull the End of the Bolt Off

Probably one-half of the valve stems which are broken and called defective by having the end of the thread broken off, are simply pulled in two by screwing on the lock nut trying to make it hold when it will not. The accompanying cut shows how one may be made which can be set twice as tight as the common lock nut and does not pull at all on the bolt or stem, but pushes together on it. The two nuts *A* and *B* are tapped to fit the bolt, while the outlet threads of each are only one-half the number to the inch as the inner thread. The two nuts may be screwed together and then both turned together as they are screwed on the bolt. When the desired location is reached the outer one is held while the inner one is screwed into the outer. The two different threads cause them to draw together and thus lock on bolt.



A DOCK NUT

Lincoln, Neb. G. G. McV.

Hydrofluoric acid is equally as efficacious in removing sand from brass castings as it is from those of iron. It dissolves the sand and not the metal, while oil of vitriol or other acids attack the metal, and not the sand. The latter is forced off mechanically by the dissolving action which takes place underneath.—*Brass World.*

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Sulphur as a Lubricant

Apropos of the several articles appearing in your recent issues regarding sulphur as a lubricant, I am reminded of an experience some years since, with a rebellious bearing that insisted upon getting hot and staying hot, without any apparent provocation.

After patience and all ordinary methods of treatment had been exhausted, a level-header looker-on suggested trying sulphuric acid. On the general principle of "any port in a storm" a neighboring drug store quickly supplied the acid, which was diluted with water and allowed to drip slowly upon the bearing while running. In a brief time—probably less than a half-hour—the bearing was cooled and had settled down to business. The acid was then washed out, usual lubricating oil substituted, and lo! the trouble was over.

I have known of several cases where this treatment of a hot box has proved to be the one thing needful, but should add, that in all these cases (if my memory is correct) the bearings were of cast iron.

Philadelphia, Penn. H. L. BUTLER.

Wabble Drills—The Big Bement Planer

There are three things that it is very easy to do: Forget, make mistakes and find fault. I guess I have said that before, but so long ago that it will do to repeat it. In my case the easiest of the three is to find fault, and I want to humor the desire just now in criticizing things in the January 2 number of the AMERICAN MACHINIST.

F. A. Dixie shows a complicated wabble drill on page 24. Why the complication, when a drill of the shape shown will do as well and is simple? He says the holes are to be spotted with an ordinary drill. Why not drill them to the required depth with the ordinary drill, and with this wabble drill at two seconds per hole enlarge the bottom?

J. P. Essex has shown on page 103 a tool for recessing long work in the turret lathe. The wabble drill shown in Fig. 2 does the work equally well and is very much more simple. First a hole full size is bored a certain distance past where the recess is to start, and a much smaller hole the balance of the way through. The wabble drill will, as may be seen, turn to

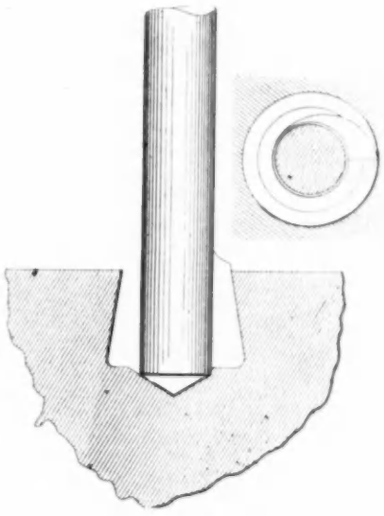


FIG. 1. A WABBLE DRILL

one side and pass down the large hole; but when the end strikes the small hole, it will be brought central and the cutter forced into the stock and a chamber started. As it is fed forward the chamber is bored to any required depth, the tool withdrawn and the small holes enlarged to the required extent.

Why so long a bed to that magnificent Bement planing machine, with special ways to true it up, when worn out of straight, which it is dead sure to do with a 60-foot bed and 30-foot table? Whereas, if they had left off 7 or 8 feet from each end, it would not have worn out of true between now and the time McIntosh & Hemphill go out of business.

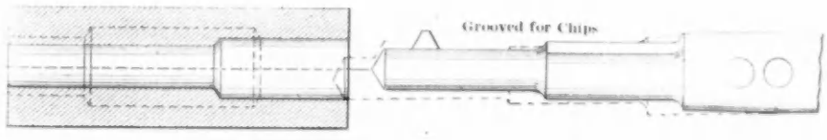


FIG. 2. TOOL FOR CHAMBERING HOLES

It's easy to tell how much shorter to make it. First make it a little too long, then if it is true when put to work, watch it and if it begins to wear more in the middle than at the ends (as it is sure to do), set a man with a hammer and chisel and chip off the ways at the ends until it evens up. This is no fancy notion, as it is exactly what we have done to the most expensive machine we had; and it is now true and will remain true, I believe, as long as it remains in use. It's a parallel case, only less in size.

By observing the wearing of a new machine it is easy to tell whether the bed and table are properly proportioned; and if wrong, courage and a file and hammer and chisel will soon correct the mistake. A hammer, chisel and file and a man to use them are easy to get; men with courage to kill people and be shot at in battle about as easy; the man who will make the slide longer is easily found; but the one who will cut off the guide that is too long is an exceptional individual.

If for some good reason the planer bed must be twice the length of the table, the uneven wear can be pretty effectually neutralized by cutting away the extra wearing surface of the ways; beginning with narrow, cut away cross bands and leaving wide lands near the middle, with the bands growing wider and wider and the lands narrower and narrower toward the ends.

A ready way to do the spacing has been given before. This doing away with the unequal wear might cost as much as correcting it when worn. But the thing that wears out of true is never right long and always gets too bad to use before it gets fixed, whereas the one that does not wear out of true is always right. It's a case of being all wrong or just right. It is quite likely that the cost of the appliance and the refacing of the ways would pay for a vertical-spindle portable milling machine and do the work of milling out the bands. The suggestion of milling machine no doubt will bring up the point to the men who make large milling machines, why the machine was ever built as a planer instead of a four-spindle milling machine.

When we come to the fun of the thing, what is there in the world worth having but enjoyment. Some men likely enjoy seeing a machine plane off an inch and a half or two-inch chip ¼ inch thick more than they do a milling cutter grinding away if it is eternally at it.

Walter Gibben, page 25, found a good many ways to drill holes crosswise through round rods, which it would seem to me rather more complicated and expensive than justified. A few square blocks with holes through the middle to fit the various size rods, and three or four

different size holes crosswise in each to fit different drills would be easy to use, give results, and be comparatively inexpensive.

JOHN E. SWEET.

I have been very much interested in the several articles that have appeared from time to time on the different forms of variable drills, and at page 24 Dixie gives a neat sketch and description of one form of such a drill. I wonder if the job could have been done satisfactorily in the manner shown in Fig. 1. That is, would the degree of finesse have been sufficient unto the case thereof?

Lay out and drill holes as shown in *X* section of plate, complete by using a flat drill as shown. The drill being longer on the one cutting edge causes it to crowd over against the side of the hole, under cutting as shown in finished hole *C*.

The above method is an old one, "fathered" by the molder's forgetfulness in

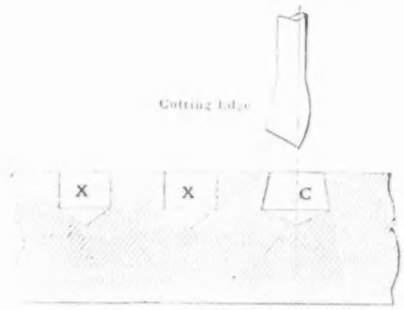


FIG. 1. THE WABBLE DRILL AND ITS APPLICATION

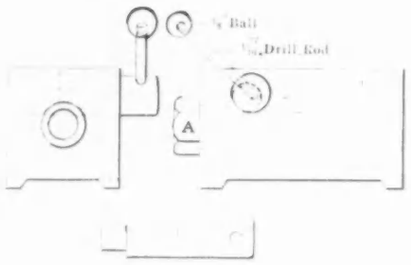


FIG. 2. A DRILL JIG FOR DRILLING COTTER KEY HOLES

not laying in the babbitt-retaining cores in engine-crank boxes, etc.

Fig. 2 shows a little drill jig which we often use in drilling cotter key holes in bolts. The small drill has a tendency to crawl between the threads—therefore it is necessary to provide some means of holding the bolt *A* from slipping back and lengthening the distance from bolt head to the hole.

Fig. 3 shows one that is rather a novelty. This was designed in the manner shown in order that both holes in Fig. 4 might be drilled in one chucking under a two-spindle press.

Elmira, N. Y. F. SELLIT.

The Inverted-V versus the Flat Lathe Bed—The English and the American Way

I have taken considerable interest in reading your editorial and the resulting discussion on the inverted-V vs. the flat-top lathe bed, and perhaps a few words from a draftsman, toolmaker and machinist (called in England an engineer) who has been abroad for a number of years, may be of interest to your readers

There are good points in both types of lathes. Certainly our American lathe is much neater in appearance, is lighter, and accomplishes the work that it was designed for. It has been found out by practical experience that the quality of work turned out very largely depends upon the mechanic, no matter what the wear is. Certainly, however, the wear of the flat-top bed is very slight as com-

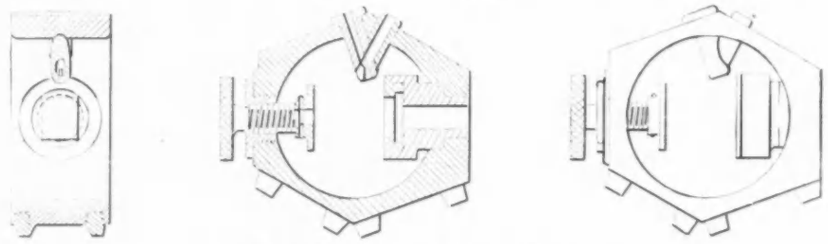


FIG. 3. JIG FOR OIL HOLE AND SHIELD

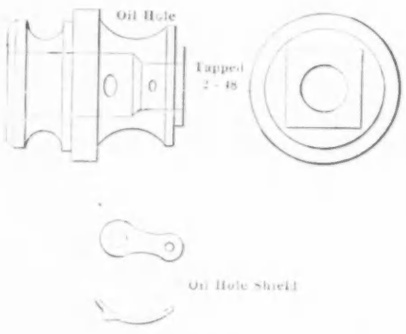


FIG. 4. WORK TO BE HELD IN JIG

pared with the wear of the V's, which becomes quite noticeable in a short time. Unless the mechanic keeps the tools sharp, he will have more faulty turning from a lathe bed badly worn upon the V's, not so much from the downward wear of the bed and carriage, as from the slackness of the under gibs in the slackest place, and he will be unable to adjust these gibs to have an equal bearing for the entire sliding surface. This is very noticeable when adopting high-speed steel and has caused no end of trouble.

SMALL WEAR OF ENGLISH LATHES

I had an occasion while abroad to go over a large number of English lathes that had been in constant use for over 25 years, and not one required the planing of the bed, but some of the back and front gibs had worn considerably, so much so that a thin feeler could be inserted at the ends. The repairing of these was an easy job as compared with taking the slack out of the gib on an American lathe. These gibs can be removed from the English carriage without taking it from the bed.

Being made to a standard angle of 45 degrees, they may be planed and scraped to the surface plate, or fitted to their own bed and carriage. With the American lathe it is of no use to fit up the gibs unless the bed of the lathe is replaned, which requires taking the entire lathe to pieces and most firms have a horror of it. It has often been quoted that the flat bed is a more expensive type to manufacture, which may be the reason for the mechanics of this country holding to the V-type.

CARRIAGE SUPPORT

While upon the matter of good points of the English lathe, let me call attention to the good bearing surface or support to the under part of the carriage. In most English lathes it is the practice to have the space between the shears as small as possible; in the smaller lathes from four to six inches, while in the larges sizes it is not much more, perhaps from six to eight inches at the most, while in the American lathes the smallest sizes have a reach of from ten to twelve inches between the inside of the V's and the larger ones from 24 to 48 inches. This puts the American carriage always in suspension, while the English bed supports the carriage so that one might say that the cutting tool practically rests upon the bed.

Taking into account the substantial construction of the lathe carriage and compound rest with the English method of holding the cutting tools, the reader will readily understand why the manufacturers of heavy work prefer the English to the American lathe.

SCREW CUTTING

Let us compare the two different types of lathes for screw cutting. Most of the American lathes require a reverse belt for screw cutting, although some of our builders during recent years have furnished lathes that did not require the reverse belt. To the best of my knowledge a reverse belt was never required upon the English lathe—certainly I never saw one so fitted. If some of the American machinists who have never seen the English

lathe were to run the carriage back by hand, their first thought, after getting the carriage started, would be the fear of knocking the tailstock off the end of the bed, for it is certainly a quick return.

Another advantage in every English screw-cutting lathe of a good make is the extra screw which is only used for cutting threads. It is a quick-threaded screw which brings out the tool to clear the thread by a half turn of the screw. This screw has a lever handle that has for its stop two very strong pins, and you have no doubt about its running past the line or pushing the threading stop that is used, or rather fitted to, the American lathe, but very rarely used. Certainly an English lathesman would never attempt to use it.

In the English lathe the amount of cut is set each time by the cross-slide screw which is fitted with a dial. This dial has fine notches milled in it and is much easier to set than the graduations usually marked upon the American lathe, and it is not so trying to the eyes.

Fast Work

During a four-years' engagement with an English firm I had the opportunity occasionally of watching an English turner cutting many kinds of threads. This man had cut the same threads upon the same lathe for over 25 years, and the prices would surprise your readers. A thread-milling machine was advocated, quotations obtained and prices estimated, and what may seem strange to your readers is the fact that it would have taken nearly 50 years to pay for this machine from the saving, to say nothing of the cost of repairs and cutters.

The two-pitch lead screw is also good, as is the method of clamping the tool.

I hope your readers will not consider that I have turned to an Englishman, but one cannot help noticing those good points after seeing them in practice.

I wonder how many American machinists, when boring a long hole in the chuck, have not wished that they could swing the headstock a little one way or the other. This is a feature that can be adjusted upon the flat type of lathe bed.

The American lathe is four to six inches too high for the English lathesman, as the majority of them are shorter in stature than the long Yankee.

Williamsport, Penn. A. I. Dodge.

Jig Bushings

In his article at page 287, P. Princeps failed to show one type of removable bushing which is not only simple, quickly removed and inserted, but as nearly accurate as a removable bushing can be. It has the advantage of having a thread and can be ground to fit the hole in the jig.

In Fig. 1, *B* is the body of the bushing which has a shot *A* milled in it. The lower part of the slot is straight and the upper part at an angle, like a screw thread. The slot engages a pin in the jig body and, because of the straight part, the bushing can be lifted entirely out of the jig. After being entered in the jig till the pin strikes at *D* a slight turn locks the bushing against the work. A handle *C* may be used or the top of the bushing fitted to a wrench.

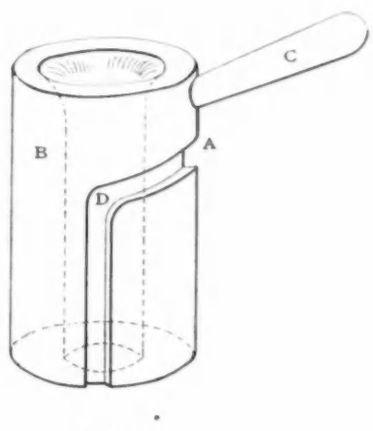


FIG. 1

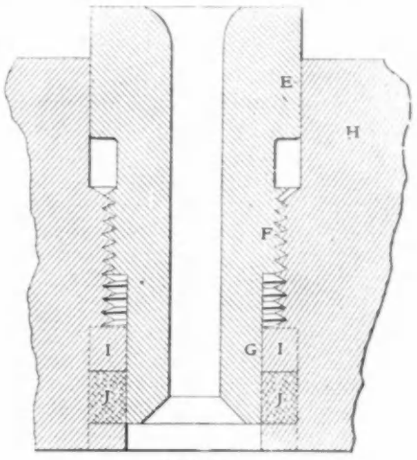


FIG. 2

JIG BUSHINGS

While writing this it occurs to me that there are many ways to make threaded jig bushings which can be ground. These I offer only as suggestions. I have never made them and I don't suppose any one else has.

I have attempted in Fig. 2 to show two forms. In the one the jig body is bored on the outside to fit the large part of the bushing at *E*, threaded at *F* to fit the threaded part of the bushing and bored at the bottom to fit the small part *G* of the bushing.

I have, by dotted lines shown a modification of this. The threaded part of the jig is the same in each. The bored proportions, top and bottom, are the same size, the lower one being shown in dotted lines at *I*. A collar *J* is fitted to the lower end of the bushing and ground to fit the lower counter-bore *I*. After the bushing is screwed into place as far as it will go the collar *J* is forced on.

I do not see why bushings made in either of these ways should not be fairly accurate, in fact much more accurate a fit for the jig body than the average drill is for the hole in the jig. E. A. Dixie.

New York.

Contraction of Steel in Hardening

On page 442 of the American Machinist, a writer on the above subject expresses a desire to hear "real solid facts" concerning the behavior of carbon steel on hardening, and I herewith give one or two which may be of interest.

I had charge of a Pratt & Whitney measuring machine for a period of about two years with which I was testing and making gages of all kinds. Pin gages up to about 4 inches long I used to make of drill rod and harden them dead hard from end to end. I always found that the hardening lengthened them to the extent of about 0.0015 per inch of length. That is to say, a 4-inch gage became about 0.006 longer. There was no need for any skill in the manipulation of the micrometer as you could measure it with an ordinary steel. Gages over 2 inches I would draw in the middle down to a dark straw and I found that this caused them to contract in length back to their original dimensions or very nearly so.

I have known a 4-inch pin gage to lengthen 0.008, but that was exceptional.

Victoria, B. C. H. C. Gunson.

Extensions on Taps, Reamers, Etc.

In general shop practice, extension taps, reamers, or drills have been a problem, as long ones are rather expensive, and it is not very satisfactory to use a long socket wrench or a monkey wrench on a short tap as it is next to impossible to tap a hole square that way.

To overcome this take a piece of cold-drawn steel about 1/8 or 3/16 inch larger than the body of the tap, put it in the lathe and drill a hole about 0.002 larger than the body of the tap, then put in a drop of acid and a small piece of solder, then heat it until the solder flows, slip in the tap, reamer or drill and you will have a job that will stand by you until the tool is worn out. By heating it until the solder flows you can remove the old tap and slip in a new one immediately.

I have used this method on taps ranging from 3/48 to 1/2 inch and find it very satisfactory. For a tap or reamer, drill a hole through the upper end and drive in a cross bar and you have a perfect wrench. G. M. Diehl.

Peru, Ind.

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

JOHN A. HILL, Pres. and Treas. ROBERT MCKEAN, Sec'y.

505 Pearl Street, New York.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Subscribers can have address changed at will. Give old and new addresses.

Subscription price $4 per year, postage prepaid, to any post office in United States, United States possessions and Mexico. $5.50 to Canada. $7 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

Hill Publishing Co., Ltd., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Business Telegraph Code.

CIRCULATION STATEMENT

During 1907 *we printed and circulated* 1,151,500 *copies of the* AMERICAN MACHINIST. *Our circulation for April,* 1908, *was (weekly, monthly and European)* 114,500.
May 7..... 36,000

This paper reaches 36,000 *separate readers each month and* 20,000 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

Contents

PAGE

A Double-ended Spindle Boring Lathe.. 707
Shortening the Time on a Contract Job 709
Engineering and Industrial Education.. 710
A Cam-grinding Rig..... 712
Vertical Boring-mill Tools and Accessories 713
Experience with the Piece Work and Premium Plans..... 715
A Double Vertical-spindle Attachment.. 717
Making Dies for Wire Drawing..... 718
Straightening a Locomotive Frame..... 719
The Factor of Safety in Ball Bearings.. 720
Work of Drilling and Milling Machines 722
Piston Rings of Uniform Strength..... 723
Some Features of a Crank Grinding Machine 725
Filing the AMERICAN MACHINIST..... 726
Letters From Our Readers:
Planing Castings too Wide for the Planer....Milling Nuts and Cutting Key Seats....Magnetized Balancing Weights....Drilling Hard Steel....Fixture for Holding Square Pieces ....Adjustable Blocking....Drill Chuck Key Wrench....Saving a Crank-shaft....Drill for Piston Rings....Tapping Device.....727-732
Discussion of the Previous Question: Sulphur as a Lubricant....Wabble Drills....Inverted V versus Flat Bed Lathe....Jig Bushings....Contraction of Steel in Hardening....Extensions on Taps and Reamers.733-735
Wanted—A Manufacturers' Bank..... 736

Wanted—A Manufacturers' Bank

Since the panic of last October much has been said about the disposition of banks to loan money for speculative rather than for manufacturing and business purposes. We do not imagine that the banks deliberately favor the loaning of money for speculation, their preference being shown in the selection of security for loans, but the result is the same as though they deliberately favored speculators rather than business men and they cannot be supposed to be ignorant of the result of their preference.

Of all kinds of securities, the most convenient for bank purposes are, no doubt, stocks and bonds. To begin with, these are the quickest of quick assets and quick assets are very desirable for bank purposes and, in addition to this, collateral of this kind has the further advantage that its value is easily determined. Of other kinds of securities a banker must depend upon his own judgment, whereas, of listed securities, the quotations of the day give the consensus of judgment of large numbers of men.

It so happens, however, that money loaned on such collateral is used chiefly for purposes of speculation and it hence results that the banks, in consulting their own interests, encourage activities which ought to be discouraged and which, could they but choose, the depositors whose money is thus loaned would be the last to favor.

So far has this preference gone that instances have come to our knowledge in which manufacturers, with orders in hand of a volume to exhaust their immediately available capital, have found it impossible to obtain from the banks accommodations for meeting their pay-rolls, to say nothing of those larger accommodations which manufacturers from time to time require.

This plainly should not be and we believe it need not be were manufacturers to pool their banking custom and unitedly favor such banks as in turn favor them.

There is nothing more proper than that a depositor in a bank should have something to say about the policy, at least, on which his own funds are to be loaned, and we believe that, by concentrating their patronage, manufacturers in towns where manufacturing interests are sufficiently large to make their patronage of moment, could easily bring about a change in the existing state of affairs.

The average business man has an idea that convenience requires him to deal with some bank in his immediate locality and we expect to have the supposed difficulty of dealing with a bank at a distance thrown up against our suggestion. This suggestion, can, however, come only from those who have had no experience with banking by mail. So far as mere convenience goes, banking by mail is preferable to banking by a messenger and in saying this we speak from our own experience. Most of our banking is done through a bank located in New Jersey to which we seldom or never go. A bunch of checks is sent to the bank each day by registered mail and the next day we get a receipt for the deposit. Balancing the account is done in the same way—the book goes to the bank by mail and it comes back with the cancelled checks in the same way and that is the end of it.

From the standpoint of convenience, there is no reason in the world why all of the machinery manufacturers of Cincinnati or Cleveland for instance, should not deal with a single bank and we believe that, by doing this, conditionally upon the banks adopting a different policy toward the manufacturers, at least one bank in each town might easily be made to see a new light on the whole subject of making loans.

A bank in each manufacturing city that made it its business to know the condition of those enterprises that employ people and produce something of benefit to the country, and who use their deposits to foster manufacturing and commercial concerns that deserve to live, ought to attract to itself the substantial people of the county.

Such a bank would soon have a board of business men whose united judgment would help the town, because it helped the depositors and the manufacturer and the merchant. It would sift out the undeserving and the doubtful and lend a hand to those who do something.

The banks that keep their surplus in quick assets for the men who gamble in prices might make more money, but ten such banks could not do the good of one sound one devoted to the building up of the productive enterprises of the community and the people would soon see and recognize the difference.

Banks should seek opportunity to lend money to deserving local concerns—a manufacturer begging for the use of capital to carry on his business, which perhaps supports half the town already, is all wrong.

A. S. M. E. Meeting

The next meeting of the American Society of Mechanical Engineers will be held Tuesday evening, May 12, in the Engineering Societies building, New York. The paper will be by Henry Souther, of the Henry Souther Engineering Corporation, Hartford, Conn., on the subject of "Clutches," with special reference to the types used on automobiles.

The meeting will be important to all who have to do with the use of clutches for machine-tool work, power transmission, hoisting machinery, texile and other classes of machinery.

The discussion will be continued at the semi-annual meeting of the society at Detroit, Mich., June 23-26.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

A New Geared Drive for a Shaper

The single pulley or constant drive is making its way into all classes of machines, and the Queen City Machine Tool Company, Cincinnati, Ohio, has designed one for its shapers which has several points of interest, being different from the gear box usually found, and following automobile practice in several particulars. Its main features are that no shifting of gears takes place under load, and that it is impossible to engage two sets of gears at once, as will be seen in Fig. 2. This is a top view showing the gear shifters *A* and *B*, both of which can be moved in either direction, as shown in Fig. 4, when the gear-shifter lever is moved in to engage shifter *A*, or moved out to control shifter *B*.

Fig. 3 shows a side view of the gear box and Fig. 4 a section. The pulley or driving shaft runs clear through the machine and carries a good sized clutch ring at the other end. This is expanded by the cone so that power can be thrown off when a change is to be made. The driving gears are mounted on the sleeve surrounding the main shaft, and this carries the clutch body, so that when the clutch is expanded they revolve together and drive whichever gear is in mesh. The driving shaft also carries a pair of sliding

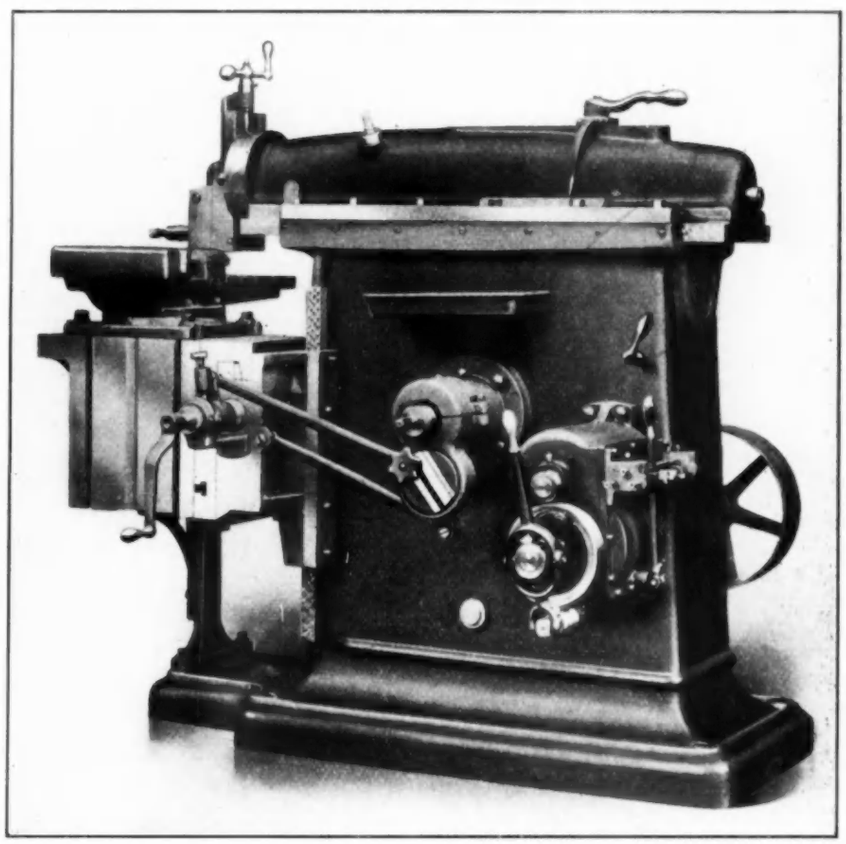


FIG. 1. QUEEN CITY SHAPER WITH GEARED DRIVE

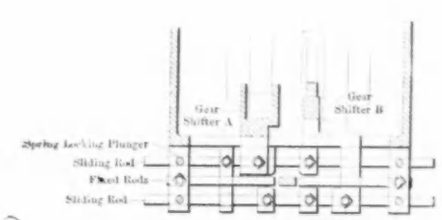


FIG. 2

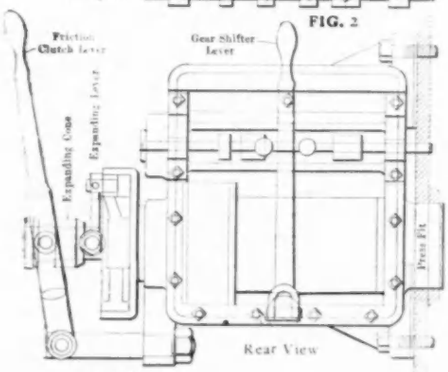
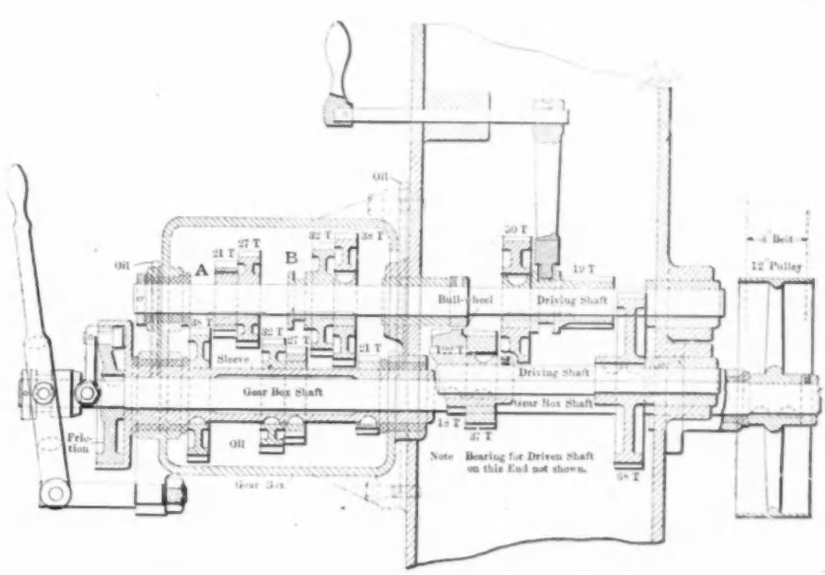


FIG. 3



DETAILS OF THE GEARED SHAPER DRIVE

gears inside the machines and controlled by the handle shown. These gears drive an intermediate shaft either fast or slow, according to position, and this carries an 18-tooth pinion which drives the bull-wheel. In this way four speeds are secured in the gear box and four more by the back gears inside the column.

The gear box is made as a unit and the hub around the main shaft is pressed into the column while the brackets are bolted to it top and bottom; but, as can be seen from Fig. 1, all parts are easily accessible by removing the cover at the back of the box. Oil pipes are provided for each main bearing and the main gears run in oil so that the whole box is thoroughly lubricated at all times. Changes are easily made, every move is positive and non-interfering, and with the pulley running at 315 revolutions per minute, strokes of 7.2 to 114 per minute can be obtained.

Heavy Motor-driven Geared Head Lathe

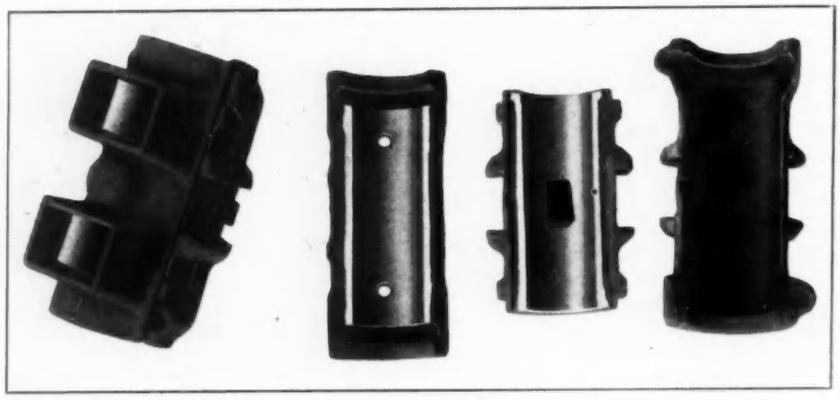
Another addition to the heavy lathes that have been made necessary and economically possible by the higher cutting speeds and heavier cuts, is the new one of the Bridgeford Machine Tool Works, Rochester, N. Y., with a 32-foot bed, built for the Jones & Laughlin Steel Company, for their Woodlawn, Penn., plant. This is built for either constant-speed belt-drive or for use with a motor as shown, this being controlled from the carriage by the wheel at the right. The motor is geared to the pulley-drive shaft, the gears being hidden by the guard, and outside of the gears is a belt-drive for rapidly moving the carriage from place to place on the bed. This is accomplished by the bevel-gear transmission to the lower feed-rod connection to the carriage, controlled by the lever at the left of the carriage. The lead screw, feed and motor control rods are supported by the two brackets shown, which are free to slide along the bed in the dovetailed ways on the front of the bed when the carriage comes in contact with them.

All gears in the head are of steel and run in oil and all bearings are constantly supplied. The speed changes are controlled by the handles and wheels shown in the usual way and all are within easy reach of the operator. These give a range of from 2 to 98.1 revolutions of the driving shaft to one of the face plate. This makes the spindle speed from 3 to 150 revolutions per minute. The motor is a 15-horse-power Westinghouse with a speed range of from 300 to 900 revolutions per minute.

The bed has a longitudinal rib with a cast rack in which a pawl from the tail-stock engages so as to form a positive stop, which is very useful on heavy work. There is also a reducing gear for moving the tailstock along the bed. The tail-stock is designed so as to clear the compound rest when set over for angular work. The spindle is 8 inches in diameter and the main bearing 12 inches long; face-plate 36 inches by 10 inches wide; swing over carriage, 25¾, and over ways, 38 inches; lead screw, 2 7/16 inches in diameter, 2-pitch; rack of steel, 2 inches wide, 5-pitch.

Hanger Box for Grease or Oil

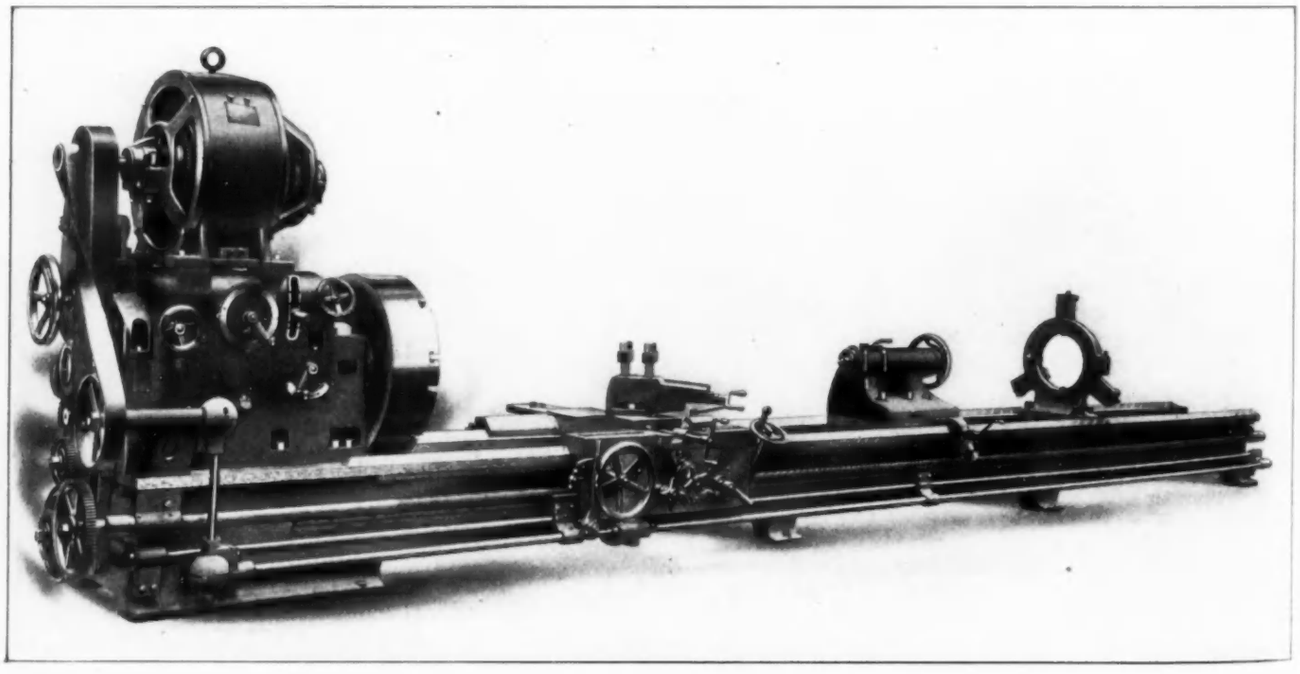
Shafting hangers are usually subjected to more severe conditions than we realize,



HANGER BOX FOR GREASE OR OIL

and those who have this branch of a shop in charge are always interested in new ideas along this line. The box shown has just been put on the market by Olney & Warrin, 66 Centre street, New York, as a result of many tests to see what was required and where some were weak.

As will be seen, this bearing is made



HEAVY MOTOR-DRIVEN LATHE WITH CARRIAGE MOVED BY POWER

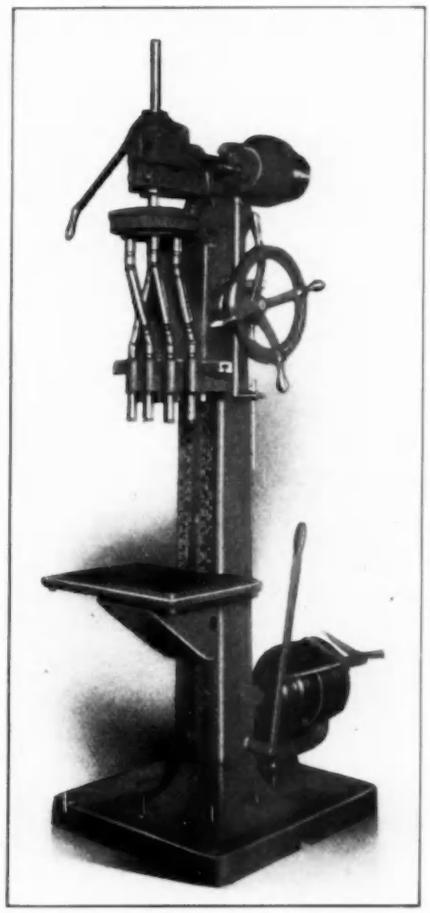
in three parts, the lower section at the right serving as an oil-well, the next is the lower shell with its heavy lining of babbitt which goes under the oil-well, and the top half is shown beside this as well as in the whole bearing at the left. This construction allows the oil-well casting to be thoroughly cleaned of sand and grit, and, as will be seen, there is a lip for oiling on each side of the box so that the grease in the pockets on top need not be disturbed. These bearings are carefully bored and reamed, all skin of the metal being removed so that there is a clean, well-fitting bearing surface from the start.

This is designed to be used with grease alone if desired, the "Howard" grease supplied by this firm being specially adapted to it, as it is claimed to work well from coldest weather to 225 degrees of heat. This is packed in the bearing with a small quantity of woolen yarn which keeps the grease in contact with the bearing at all times.

Adjustable Multiple-spindle Drill

This is one of a series of adjustable multiple drilling machines, recently designed to take the place of the ordinary multiple drilling machines with fixed spindles. It is adapted for drilling a number of small holes up to ½ inch in the parts of automobiles, typewriters, electrical devices, and similar work. It is easily handled and changes can be made from one series of holes to another in a very short time.

They are made with a varying number of spindles, which have an adjustment forward and back of 3 inches and sideways of 15 inches, the minimum distance between any two spindles being ordinarily 1¼ inches. Each spindle is also capable of adjustment vertically to allow for the use of drills of different lengths and has a No. 1 Morse taper hole, or chucks can be fitted direct to spindles, if desired. The rail or head which carries the spindles is counterbalanced by a weight inclosed within column. The table is 16x12 inches supported on a very rigid inclosed box knee to insure rigidity in drilling, is adjustable by rack and pinion and has an ample working surface surrounded by oil



MULTIPLE DRILL WITH ADJUSTABLE SPINDLES

groove; the size and shape can be changed for special work.

The countershaft is attached to the base, is fitted with tight and loose pulleys and has self-oiling bearings. Drive gears and spindles are made of the best carbon steel. Machines are made with or without direct-connected all-gear feed and with or without tapping attachment, and they can easily be adapted for individual motor drive. It is well suited for working in gangs, several of them being mounted on a common base and arranged to work together or independently in groups. They are made by William Gardam & Son, 221 Fulton St., New York.

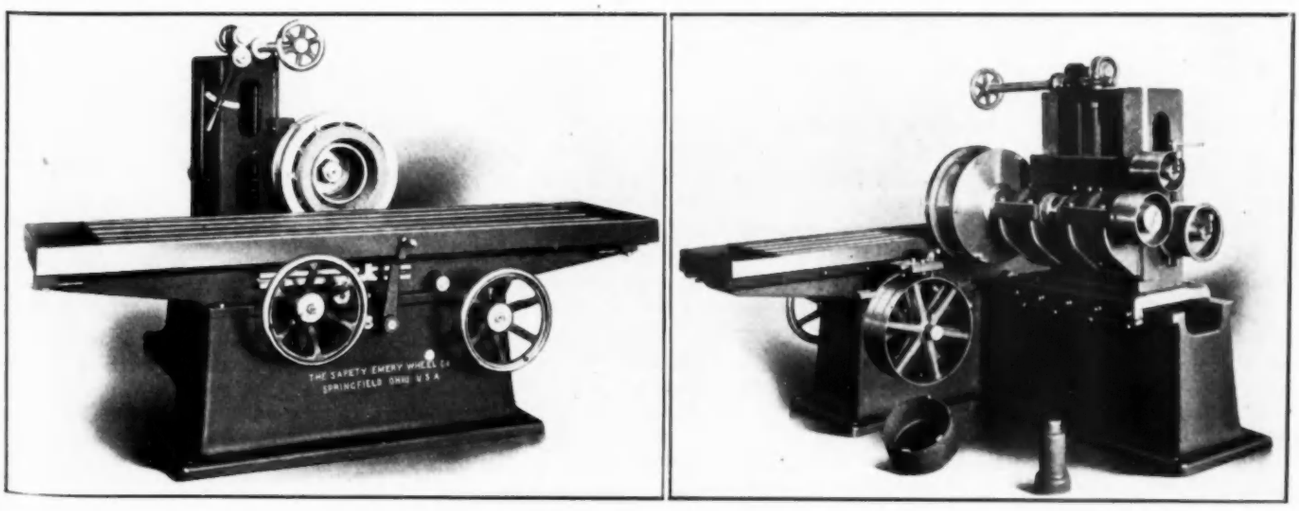
An Automatic Edge Grinder

There are more places where castings of iron, brass, or steel can be finished from the rough by grinding than we are apt to realize, and this machine has been designed to handle flat edges and surfaces of much work as might ordinarily be done on a milling or planing machine.

The base is in one heavy casting with an extra long bed for the table which runs on one V and one flat way. The wheel spindle is substantially mounted on the sliding head, powerfully driven by the aid of idlers which insure a good belt contact at all times, and carries a ring grinding wheel in a safety chuck. Thrust bearings are provided, and there is a vertical adjustment of 12 inches either by hand or power.

The wheel-grinding head is fed to the work by a large feed screw operated automatically by the carriage dogs and the mechanism at the front of the bed.

The dogs, as shown in the front view at each end of the carriage or table, are threaded pins providing for fine adjustment. At extreme travel these dogs operate on the sliding rack, which in turn is connected through the train of gears to the gear and ratchet-plate sleeve on the feed screw. This ratchet plate is directly behind the large hand-wheel at the left. The hand-wheel is secured to the feed screw and acts as driver, when feeding automatically, by engagement of the pin located on the hub. When feeding by hand, the pin is disengaged. By proper

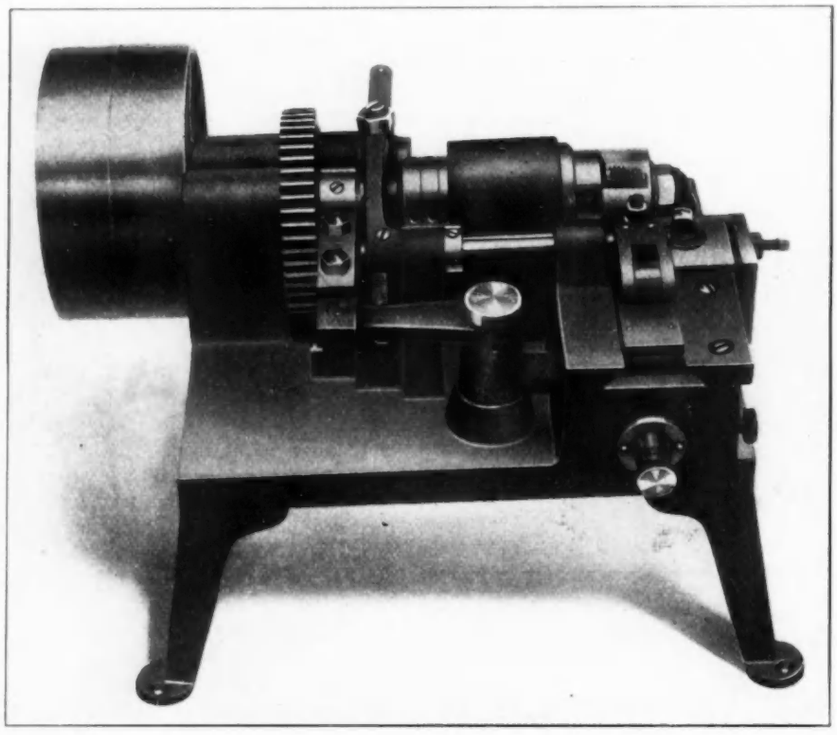


FRONT AND BACK VIEW OF AUTOMATIC EDGE GRINDER

adjustment of the dogs, any desired feed from 1/1000 to ⅛ inch may be secured.

The motion of the carriage is under perfect control of the operator and can be stopped at any desired point by centering the reverse lever, or run back and forth by operating the lever by hand, or by means of the large hand-wheel in front.

All the operating mechanism is in front and within easy reach from one position. Reversal of carriage or table is accomplished by action of the solid dogs on the reverse lever, as shown projecting upward toward the surface of the table. This lever is connected by link and crank mechanism through the base to the cam plate in the rear, directly above the driving pulleys. The table is driven by rack, which is triple back-geared to the center driving pulley. The cam plate operates the belt loops, guiding belts, one straight and one cross, from the countershaft, the same as a planer.



A SOLDER-CUTTING MACHINE

The machine is fitted for supplying water to the grinding wheel when so desired, as is necessary when grinding steel, etc. The rear base serves as a reservoir for abundant water storage and the water is delivered to the wheel by centrifugal pump.

It is also furnished with a heavy knife bar, such as is used on a knife grinder, which can be bolted to the table for grinding any length of knife up to the capacity of the machine, and readily removed when not needed.

The sizes of the table working surfaces vary from 50x17 inches wide up to 130x17 inches wide, the larger sizes having central base with pedestal end supports for the bed. These are built by the Safety Emery Wheel Company, Springfield, O.

Solder Cutter for Jewelers

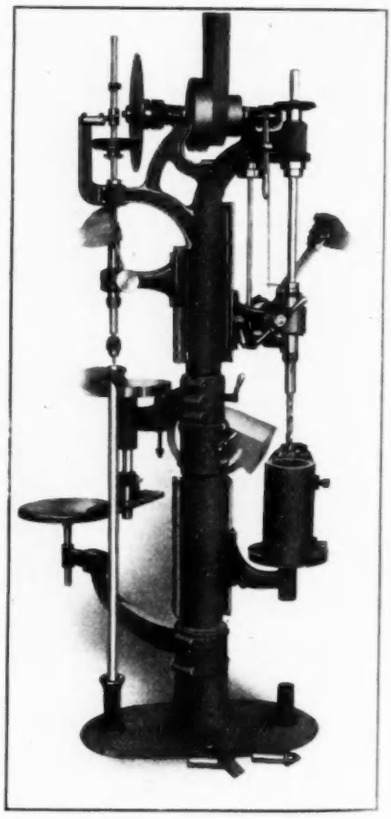
In the manufacture of jewelry a large quantity of cut solder is used, and it often happens that the time required for a piece of work, as well as its appearance or durability, depends on the right amount of solder being placed in the joints at the start. For this reason manufacturing jewelers use solder-cutting machines so as to cut up pieces of exactly the right size for the work in hand, and the machine shown is one of the latest developments along this line.

This consists primarily of a cam shaft which is driven by the gear and pinion shown at the left. At the right-hand end of this cam shaft is the solder cutter itself, and the flat stock solder to be cut goes in under the small roll shown and between that and the dovetail slide which is underneath. This slide is operated by the lever shown, which in turn derives its motion from a cam on the right-hand side of the large gear, and this gives a predetermined motion to the slide according to the size of the piece of solder to be cut off. The solder is held down against this moving slide by the small roll before referred to and this roll is operated through the shaft and arm shown, so as to hold the stock solder firmly against the slide, but at the same time allow it to move back and forth with it under this roll. Then at the proper moment it is released so that it can be set forward for a new cut, after which the roll again clamps it to the slide.

The feed is adjustable and can be changed while the machine is in operation by simply moving the micrometer screw, shown in front, for any desired length of piece, and the use of this micrometer also allows any size to be duplicated at any time to within less than one-half a thousandth of an inch, which is rather fine graduation when it comes to cutting solder. As will be seen, the cutting knife is well supported, and the whole machine designed to withstand the strain to which it is subjected, although it is, of course, a comparatively light machine, being built for bench use. It is manufactured by the E. C. Bliss Manufacturing Company, 91 Sabin street, Providence, R. I.

Combination Drill Press

This is a rather novel combination, as it includes a sensitive drill and a hand or power-feed gear drill on the same frame, so that either or both can be used at the same time. The sensitive drill is driven by a friction disk and will drive a ⅛-inch drill while the other side handles anything up to 1 inch. This can also be used as a knee feed in which the operator's knees come under the cross-bar attached to the lower end of the cable spindle and feeds the work against the drill leaving both hands free to hold the work. A stop is provided for this work



A COMBINATION DRILL PRESS

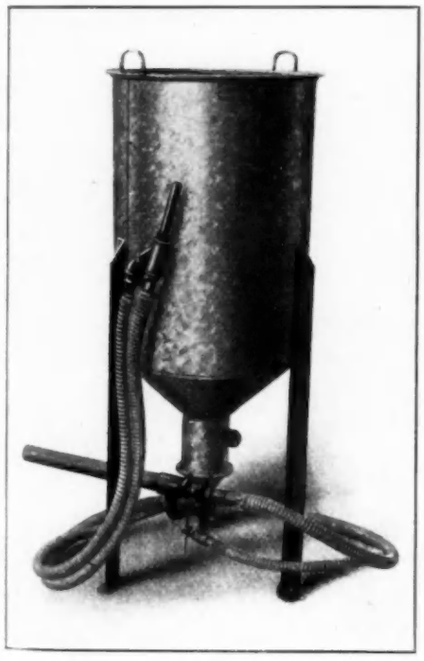
Or this can be swung out of the way and a much greater distance between the drill and the table secured by using the lower table which is on the dove-tailed slide on the face of the column. This table can be used on either side of the drill by transferring it to the opposite face.

Under the geared spindle of the drill is a 13-inch square table which can be swiveled or the other table can be swung around under this drill should it become desirable as both of these swivel on the round column and can be moved in any desired position. The same is true of the operator's seat and in either position it saves the time often spent in hunting up a box of the right hight.

The drill will accommodate work up to 14 inches in diameter on either side as the center of the spindle is 7½ inches away from the face of the column. The fixtures shown on the base are convenient in drilling long stocks and particularly for centering it. On shorter work the cup center can be placed in either the upper or lower arm under the sensitive drill and adjusted to suit almost any length of work that will be handled. This machine is made by The Lapointe Machine Tool Company, Hudson, Mass.

Sand-blasting Machine

This has been designed to give small foundries an opportunity of using the sand blast without an extensive equipment, and differs from the usual machine in several ways. As the air does not go through the machine itself, it is unnecessary to make it of steel, and instead the body or hopper is of galvanized iron supported by three iron legs. In the top of this is a conical sieve into which the dry sand is thrown and through which it automatically works down into the mixing chamber at the bottom.



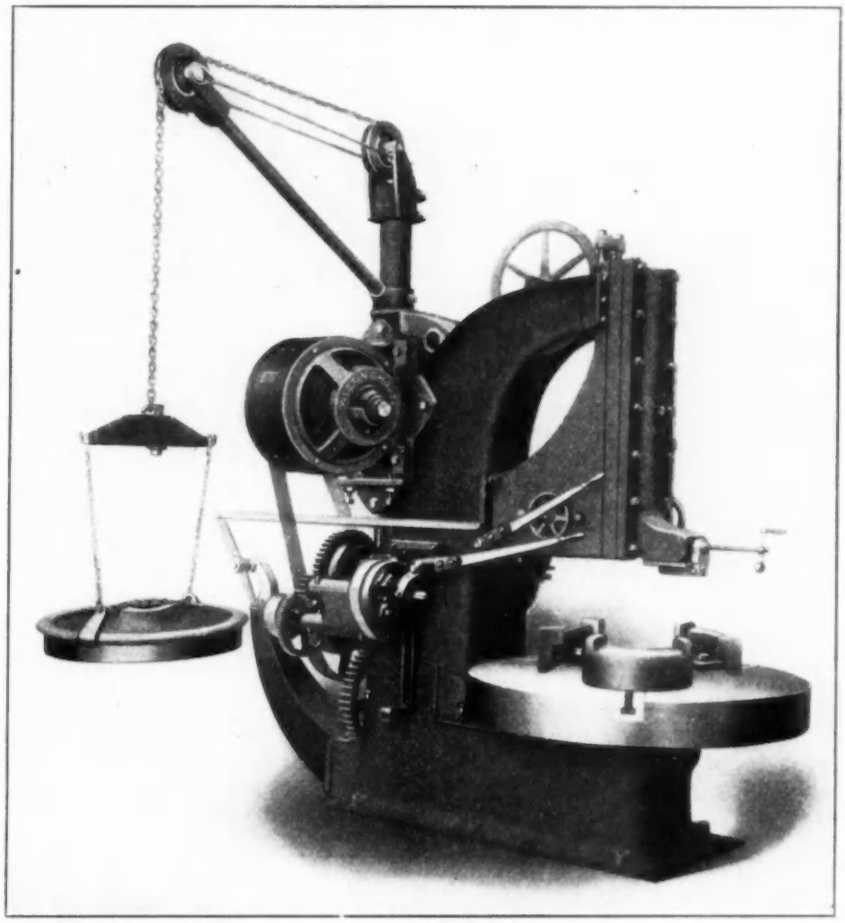
SAND-BLAST APPARATUS

The air goes directly from the compressor to this mixing chamber, and the vacuum here created helps draw the sand through the sieve and into the sand pipe, which is the one to the left of the air pipe. The air from the compressor comes in at the large pipe at the bottom of the machine, and the sand and air are mixed in the Y just behind the nozzle. When a blower is used, instead of air being taken from an air compressor, the sand pipe is attached to the connection shown at the top of the mixing chamber instead of at the bottom, as shown in this case. Mixing the air and sand at this point makes it possible to use a perfectly straight nozzle, which avoids the excessive wear occurring in nozzles which are made tapering, and this nozzle can be made several feet long, if it is more convenient for the work in hand. The machine holds enough sand for three or four hours' continuous operation, and is supplied with 10 feet of hose on both connections so as to allow quite a large radius of action.

When a pressure blower is used, an oil separator is placed between the blower and the mixing chamber in order to prevent any oil being drawn into the sand from the blower itself. This is also arranged to be mounted, together with a blower driven by an electric motor or gasolene engine on a portable truck, so that it can be taken to any part of the plant that may be desired. This machine is built by Leiman Bros., 130 Centre street, New York City.

Motor-driven Car-wheel Boring Mill

This is a 54-inch car-wheel borer of heavy construction and powerful gearing, to handle the heaviest cuts required for this class of work. The automatic chuck



MOTOR-DRIVEN CAR-WHEEL BORER WITH AUTOMATIC CHUCK

is self-closing, self-opening and self-centering, and has three adjustable abutments, each provided with an equalizing steel jaw with two bearing points. The work is thus held and centered by six points on the circumference, insuring accuracy in centering.

The upper part of the table which carries the chuck-jaw slides is provided with a separate track bearing attached thereto at three points, leaving three openings for the arms of the bevel-driving wheel. This wheel has a long hub carrying on its upper end the cam ring which, by its rotation, opens or closes the jaws. The first action of the driving pinion when the ma-

chine is started is to rotate the bevel wheel by rotating the cam ring to draw the jaws together, clamping the wheel. When the motion of the jaws ceases the table will rotate with the gear. If the pinion is suddenly stopped, the bevel wheel being checked, the table by its momentum will continue to move until the jaws are unlocked. If it is desired to stop the table without unlocking the jaws, it is only necessary to bring it to rest gradually. The jaws themselves are of two parts, one clamped firmly to the slide, and the other—the jaw proper—is pivoted on the lower piece so as to equalize the pressure on the two ends of the jaw, thus centering the wheel by the average of six points on its circumference. The lever which disengages the driving clutch also applies the stopping brake.

The work is secured in its correct position in the machine and released with no loss of time and without labor. Since the power of the clutch grip increases with the resistance of the cut, it is never necessary to stop the table to tighten the chuck. The boring mill is especially arranged for electric drive, and the motor is mounted on the vertical housing of the frame. The motor is a 7½-horse-power Westinghouse type "S", for a variation in speed of approximately two to one, which eliminates the cone pulley required by line-shaft drive. This increases the machine capacity, because the variable-speed motor gives the desired range of speed in much smaller steps, permitting the mill to be run at all times at its maximum. The boring mill is made by William Sellers & Co., Inc., Philadelphia.

A Level That Indicates by Gravity Instead of the Usual Bubble

The engravings show a level which has recently been placed on the market and in which there is no liquid with its usual bubble, but instead the action of gravity

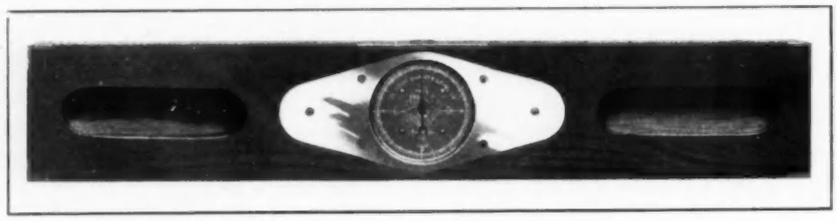


FIG. 1. A LEVEL THAT WORKS BY GRAVITY

is used to show when a piece of work is level or to show the amount of variation if any exists. Fig. 2 shows how this is accomplished by the aid of a comparatively heavy pendulum which operates the large gear wheel shown at the center. The dial of the level is marked so that every division shows twice the amount per foot that the level is out. That is, if the work is one foot long and the pointer swings to ¼ inch either side of zero, the work is out ⅛ of an inch in that direction. It it is used on a long piece it is of course necessary to multiply the error per foot by the total length to find the amount one end is higher than the other. It can be used in any kind of work the same as any other level and indicates from the vertical in either direction as readily as from the horizontal. It is provided with a brake or damper which can be used to either hasten its coming to a stop or to prevent movement of the pendulum during shipment. This is made by T. F. Deck Gravity Level Company, Toledo, Ohio.

FIG. 2. THE PENDULUM AND GEARS

Some Vicissitudes of the Job Shop

By J. G. Dornbirer

After running an account with the boss for repairs on an old ex-traction engine, the owner came over one day and offered to square up by giving the engine for the account. Knowing the state of affairs, the boss decided to accept. The wheels had been removed long ago; the rear end had been standing on the ground; the front end stood on a block. The lower end of the fire box was badly rusted, so we cut it off about 1 inch above the mud ring, put in several new flues, replaced the mud ring and tested it to 150-pounds cold-water pressure. Then we cut off the axle trunnions and riveted on a pair of legs, and a sort of a pedestal for the front end.

Then we repaired the engine from stem to stern, and gave it a coat of paint. It now appeared to be a good, salable article. We fired it up and it ran. Within a short time we had a customer for it. The party paid about 20 per cent. down and the balance was due in semi-annual payments, with a chattel mortgage to the boss for security. Now most sawmill engines in those days had no governor, and were usually operated by the sawyer with a rope attached to a butterfly valve, which had a spring or weight so applied that when the rope was slacked off the valve would throttle the steam. Here is where poverty again proved to be the mother of invention.

We will call our customer by his first name for convenience. Silas was a poor man; he bought a small sawmill; his wife and he were the sole employees. Yet even this small concern had its labor troubles. The wife was a large, robust log roller that could take her place beside any man, and Silas, as we were told, was not allowed to disseminate on account of sex.

Well, in order that he could give his entire attention to the work he had to rig up a sort of a governor. This is how he did it: The center distance of engine and saw shafts was about 25 feet. About mid-way between them he had a belt tightener mounted in a vertical frame. When the load came on the saw the belt would become taut on the lower side, and the tightener would slide down in the frame. By means of the rope connection with the butterfly valve, the valve would open and shut just about as promptly as if operated by any governor.

After a few months, Silas reported that he had to fire "like the very old scratch" to keep up steam. So the boss and I went out to see what was the trouble. The engine blew almost a continuous exhaust. We removed the cylinder-head, turned on a little steam and found the following: At some earlier stage of its existence the engine had a piston-rod put in by a job shop far from a base of supplies. A piece of shafting having a keyseat in one end was used for the rod. This keyseat was about the same length as the piston was thick, and of an unusual size, 9/16x1/4 inch. It had evidently been plugged, as we did not notice in the shop that there was an opening through the piston from one side to the other; but the plug must have passed out through the exhaust, as we could not find it. We plugged it again and everything apparently went well, except that the flues and seams leaked a little.

When the payments came due, Silas wanted an extension of time, claiming that the trouble on the engine prevented him from making good. It was granted. When it came due again he wanted more, but the boss got suspicious and replevined the engine. We went out with the sheriff and got it. On examination, we found that it had been almost ruined from low

water; everything in the firebox leaked.

Well, Silas came to town and filed suit against the boss for damages. In court his witnesses testified that the boiler in spots was no thicker than brown paper and how frightfully it leaked with 80-pounds pressure. The court never seemed to notice these incongruities, but marveled that all living things within a radius of half a mile were still able to bear testimony. The plaintiff's attorney then rose and asked their "alienist" for his opinion. Say, I wish you could have heard it; it was enough to make a feller laugh. For ambiguous terms he had the proverbial colored preacher "skinned a million years." He said that he was no ordinary machinist, but that he was a millwright of the highest order. Then the pettifogger asked him as to the length of his experience. He answered "30 years." The boss was also asked and answered "eight years." Then the lawyer, with a rising inflection, pointed to the millwright and said "30 years" and, with a falling inflection, to the boss and said "eight years." It was done right up to the "handle dramatic."

The facts were that the boss had served a four years' apprenticeship in a large engine-building concern, several years in a leading polytechnic institute, and a year and a half in the largest machine-tool establishment in the central West. While it developed that the millwright had once upon a time built the track for a log carriage in a sawmill and some wooden grain spouts in an old elevator.

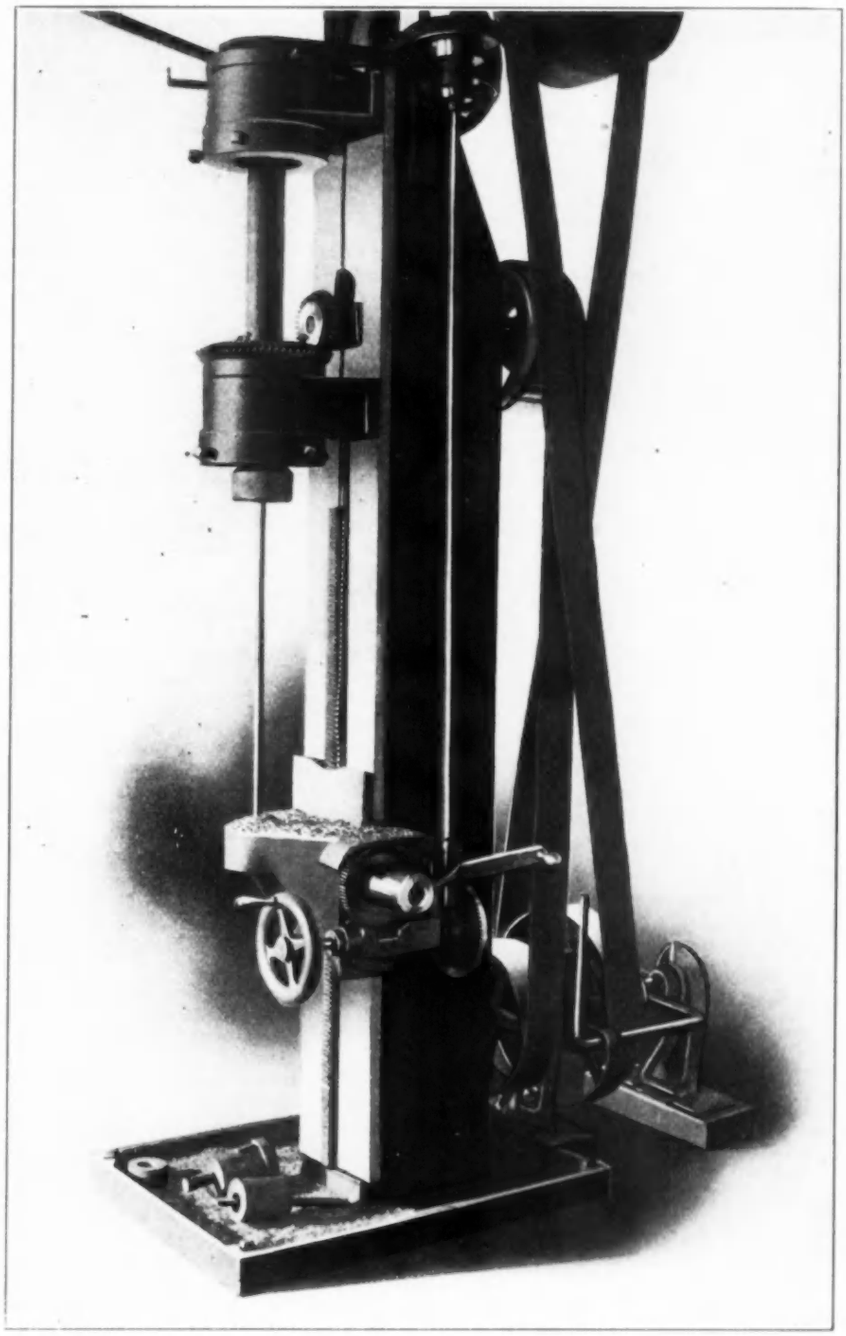
Well, Silas got judgment against the boss for $56 and costs.

The lawyer for the plaintiff died within a month, and the court ordered the boss to settle direct.

In a week or two the boss and I drove out to settle with Silas. When we arrived we saw a little man run for the barn, as if to save his life. We went in and were met by a woman; judging by what was apparent to all, the Darwinian theory could have been verified by going back about two generations in her ancestral tree. We asked for Silas and she pretended not to know of any such person. The boss told her that he owed Silas some money and had come to pay it. Then she remembered that she had a husband once by that name, but that he had died about three weeks ago. Then pointing to the little fellow whom we saw making a bee-line for the barn as we drove up, she said that he was "it" now. With a gesture, she commanded him to step up to the front. He had nothing in his favor, so I will say nothing against him. She wanted to impress us with her knowledge of law, so informed the boss that, according to law, she had no right to more than one-third of her husband's goods. This amount she would accept; but since Silas was dead, she would receipt for him for the balance. Well, we settled.

A Vertical Machine for Deep Drilling

The accompanying illustration shows a machine at the works of the Oesterlein Machine Company, of Cincinnati, for drilling the holes in its milling-machine spindles. The machine will be seen to be extremely simple and of moderate cost and it has been found more satisfactory than the elaborate machines which have come into extensive use elsewhere.



A VERTICAL MACHINE FOR DEEP DRILLING

The spindle to be bored is shown in position between the two heads, of which the lower one is the driving head, driven in the manner clearly shown. The drill is of the ordinary flat pattern made of Novo steel, the feed being by the head which carries it. The work is held by set screws as clearly shown and the hole is started by a short stub drill of which two are shown lying within the base pan and which are inserted in the socket occupied in the picture by the long drill.

The machine being vertical, the chips fall away by gravity and without the use of a forced stream of oil. The actual drilling is, of course, slower than if oil were used, but on the other hand the machine requires no attention when once started, so that the time consumed in boring a spindle is of little account. This, combined with the fact that the outfit is

obviously of low cost, would indicate that the machine is a close competitor with the highly elaborated ones which are now so common. There are two sides to the question of highly organized machine tools and this simple and low-cost machine is an illustration of the side of which too little is heard.

Machine Tool Builders' Convention

The regular semi-annual convention of the National Machine Tool Builders' Association will be held in Atlantic City, on Tuesday and Wednesday, May 19 and 20, with the Hotel Chalfonte as headquarters.

At this time, after a period of business depression, during which time the value of the association was much in evidence, the convention will be an important one, and a thorough discussion of the situation can only prove of benefit to all concerned. Several important committees are to report their findings, notably among which will be the cost system committee.

The executive committee is anxious that this convention be largely attended, and looks forward to a substantial increase in membership.

As a result of a two-years' trial of a four-cylinder balanced simple locomotive, the London and Southwestern Railway has put into service a number of this type for heavy passenger haulage. The boilers have 2210 square feet of tube surface, 160 feet more in the fire box, and 357 in cross water-tubes in the firebox, making a total of 2727 square feet. The grate area is 31.5 square feet. All four cylinders are 16½ by 26 inches, the exterior being coupled to middle drivers, and the interior to forward drivers. The drivers are six feet in diameter. The engines weigh each 52 tons on drivers and 75 tons complete.

Business Items

Chas. F. Smith, designer of automatic machinery, formerly at 141 Varick Street has taken new quarters at 260 West Broadway, New York.

The district office of Allis-Chalmers Company at San Francisco, Cal., has been moved to the Phillips building, 599 Mission street.

The New York office of the Standard Gauge Manufacturing Company, Syracuse, N. Y., has been moved to room 1770, Hudson Terminal buildings.

On May 15 the address of Foote Brothers Gear and Machine Company will be changed from 24-30 South Clinton street to 44-50 Carpenter street, Chicago.

The Canadian Crocker-Wheeler Co., Ltd., Montreal, has been formed for the manufacture and sale in Canada of the Crocker-Wheeler electrical apparatus.

The factory and main office of the T. R. Almond Manufacturing Company has been moved to Ashburnham, Mass. At the New York office, 40 Murray street, a well assorted stock will be carried.

Trade Catalogs

Canadian General Electric Company, Ltd., Toronto, Canada. Catalog of ignition appliances and auto accessories. Illustrated. 92 pages, 5x8 inches.

The C. I. F. Company (Export Commission Merchants), 11 Broadway, New York. Pamphlet entitled "Problems of the Export Trade" and which gives the solution. 18 pages, 8½x11 inches.

General Electric Company, Schenectady, N. Y. Bulletin No. 4584, illustrating and describing CQ motor. 12 pages, 8x10½ inches. Bulletin No. 4576 on 4500-volt oil break switches. Illustrated. 12 pages, 8x10½ inches. Bulletin No. 4578 describing railway motor controllers. Illustrated. 12 pages, 8x10½ inches.

Manufacturers

The roundhouse of the Rock Island Railroad at Sayre, Okla., will be enlarged.

The Elkhart (Ind.) Motor Company has commenced construction of its new factory.

The Cotton Belt Railroad will rebuild the roundhouse at Jonesboro, Ark., recently burned.

The New London (N. C.) Development Company contemplates the erection of a large cotton mill.

A three-story addition will be built to the plant of the Rock Island (Ill.) Sash and Door Works.

The Stecker Electric and Machine Company, Detroit, Mich., has had plans prepared for a factory building.

The Pearl Glass Company, Clarion, Penn., whose plant was burned recently, will rebuild at a cost of about $75,000.

The William Page Boiler Company, Meadville, Penn., has awarded contract for the erection of two new buildings.

Wood Brothers Company, Des Moines, Iowa, will enlarge its plant and engage in the manufacture of traction engines.

The Vollrath Manufacturing Company, Sheboygan, making enameled ware, will build a brick factory and warehouse.

The Jenney Electric Manufacturing Company, of Indianapolis, has acquired a site at Anderson, Ind., to which place it will move.

Contracts have been let for a new factory building by the Malleable Iron Company, Dayton, Ohio, near the present plant.

The Cutler Manufacturing Company, Rochester, N. Y., making letter chutes, is erecting a new factory building to cost $24,000.

The American Hide and Leather Company, of New York, is looking for a site in Manitowoc, Wis., on which to establish a tannery.

The iron works and pattern shop of the Smith-Loughlin Company, Brooklyn, N. Y., were destroyed by fire. Loss, about $50,000.

The plant of the Simmons Manufacturing Company, Chicago, Ill., makers of iron beds, was destroyed by fire. Loss over $100,000.

The planing mill and show-case factory of the Inland Mill and Manufacturing Company, Spokane, Wash., was burned. Loss, $40,000.

The plant of the Hubley Manufacturing Company, Lancaster, Penn., was destroyed by fire, causing a loss of over $50,000. The company manufactured iron toy castings.

The General Manufacturing Company, Elkhart, Ind., building special machinery, is planning the enlargement of the plant and special attention will be given to the manufacture of gasolene engines.

The Aluminum Manufacturing Company, Connellsville, Penn., has been formed with $30,000 capital, and will erect a plant at South Connellsville. J. A. DeWitt, C. D. Schell and others, organizers.

Want Advertisements

Rate 25 cents a line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa

If you use small gears in large quantities, write Berry & Parker, Erie, Pa.

Steel case hardened; modern methods. Boston Gear Works, Norfolk Downs, Mass.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Wanted—Copy of January 3, 1907 issue American Machinist. Box 114, AMERICAN MACHINIST.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Automatic machinery designed; special purpose machines; working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia.

Shop in Massachusetts well fitted for electrical work desires machinery to build to order or by contract. Box 112, AMERICAN MACH.

We are equipped to turn out twice the number of gears used on our own work, can we do yours to fill in? Samuel M. Langston, Camden, N. J.

Wanted—Shaper, about 20" stroke. Vertical power feed to head. Must be in good condition and a bargain. Box 29, AM. MACHINIST.

Complete set of blue prints and instructions for building model air-ship; inexpensive. Price 50c. Aeriel Navigation Co., Box 148, Hartford, Conn.

Gears cut to order, bevel, spur and miter, on Bilgram and Gleason machines. Complete gears furnished. The Cincinnati Gear Works, Murdock Bldg., Cincinnati, Ohio.

Hardening Tool Steel to diamond temper tough inside, no cracks, burns or warps, cool in pure water. Sample can prepaid. 24c. King Steel Co., 55 West Jackson Blvd., Chicago.

A thorough mechanic wishes to buy an interest or outright, a small machine shop, which is so situated as to permit growth as developed; A-1 reference. Box 78, AMERICAN MACHINIST.

Valuable United States patent for sale outright or on royalty. The latest continuous blueprint machine. B. J. Hall, 41 Castelnau, Barnes, London, England.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Machinery built to order and by contract; special parts made; gear cutting, automobile and pattern work, punch press and screw machine work, tools, dies, etc. Blair Tool and Machine Works, West and Morris Sts., New York City.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Machinists take notice. Purchase castings and blue prints of high grade gasolene motor, of world-wide reputation and at a profitable business. Write today. F. P. Conrad, 242 Freeport St., Harrison Sq., Boston.

British patent rules, 1908. We can produce light fine engineering and mechanical specialties and tools, accuracy and finish guaranteed. Model Manufacturing Co., 52 Addison Road, North, Holland Park, London.

Machine screws in small or large quantities direct from factory at low prices. Send particulars of sizes and threads required. Box 97, AMERICAN MACHINIST.

Lathe and machine work of every description, patterns, gear cutting, screw machine work, iron, brass and aluminum castings.

The Sipp Electric and Machine Co., Paterson, N. J.

Make money by patenting and selling your invention. Must be useful. Delay dangerous. E. P. Thompson, M. E., Registered Patent Attorney, Member A.S. M.E. and A.I.E.E. Door 40, 39 Cortlandt St., New York.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Draftsman and mechanic; experienced designer of labor saving tools, jigs and fixtures, gas motors, automobiles and motor boats. Box 77, AMERICAN MACHINIST.

CONNECTICUT

Wanted—Position as general foreman; 13 years' experience; go anywhere; references furnished; married. Inquire 6 Summer St., Norwich, Conn.

ILLINOIS

Experienced mechanical and electrical draftsman wants a position. Box 106, AMERICAN MACHINIST.

Designer with experience on machine tools and special tools and fixtures wants a responsible position. Box 116, AMERICAN MACH.

Foreman with experienec on intricate special machinery and tools for manufacturing wants employment in the Chicago district. Box 108, AMERICAN MACHINIST.

MASSACHUSETTS

Experienced designer on automatic and special machinery. First-class references. Box 111, AMERICAN MACHINIST.

General foreman or superintendent; good executive and thoroughly up to date; East preferred. Box 86, AMERICAN MACHINIST.

First-class metal patternmaker, experienced on hand and molding-machine patterns, wishes position. Will go anywhere. Box 938, AMERICAN MACHINIST.

Position as mechanical engineer or superintendent by a technical graduate; twenty years' experience as draftsman, engineer and superintendent. Box 75, AMERICAN MACHINIST.

NEW JERSEY

Mechanical draftsman wishes position. Box 89, AMERICAN MACHINIST.

Situation wanted by young man of 17, handy around machinery, wants to learn engineering. Box 105, AMERICAN MACHINIST.

A young, up-to-date mechanic, with seventeen years' experience on tools, dies and experimental work; have held position as inspector and had charge. Would accept any position of trust. Box 101, AMERICAN MACHINIST.

NEW YORK

Responsible position wanted by practical mechanic. Expert designer of special machinery and tools. Box 107, AMERICAN MACHINIST.

Mechanical engineer and designer with wide experience in heavy machinery, hoisting and conveying machinery and structural work, open for engagement. Box 118, AM. MACHINIST.

Draftsman, nine years' shop and office experience. First-class detailer and tracer; references. Any location. Box 110, AMERICAN MACHINIST.

Superintendent or manager, twenty years' experience in general foundry and machine business. Engine or like line preferred. Box 109, AMERICAN MACHINIST.

Position as superintendent or factory manager by practical mechanic at salary of not less than $4000. Can buy interest in good prospect. Box 34, AMERICAN MACHINIST.

Inventor and engineer; highest standing as developer and designer of machinery; man of business and character; with one concern past ten years; wants situation. Box 98, AM. MACH.

Mechanical engineer, partner in machine business in Sweden, wants position at machine selling or machine factory that should like to be represented in Sweden. Box 103, AMERICAN MACHINIST.

Mechanical engineer, nine years' experience on Taylor system, open for engagement June 1. Good chance for shop to introduce modern methods at low cost during dull times. Classification, speeds, feeds, tools, rearrangement etc. Box 104, AMERICAN MACHINIST.

OHIO

Good wood patternmaker wants work anywhere, 26. G. Hargreaves, 1528 Prospect Ave., Cleveland, O.

Machine designer and draftsman desires position. Eight years' experience. Best of references. Box 95, AMERICAN MACHINIST.

Expert cost accountant, young man at present manager of the department of factory organization and costs for a large audit corporation, desires an executive connection with a large manufacturing concern where results are imperative. Box 115, AMERICAN MACHINIST.

PENNSYLVANIA

Engineer, draftsman, mechanical, A-1, experienced. Box 117, AMERICAN MACH.

VIRGINIA

Young man, now general manager $50,000 general machine shop, desires similar position or one as assistant superintendent. Good credit man, practical machinist, technical graduate and can furnish A-1 references. South preferred. Box 113, AMERICAN MACHINIST.

FOREIGN

Master mechanic; American; age 37; responsible man with large and varied experience manufacturing, erecting and maintaining; successful in producing high grade work at lowest cost; at liberty July 1; Pacific Coast States only; state salary. B. Nilius, Master Mechanic, Rio Blanco, Peru, via Lima.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—First-class draftsman and designer. Capable of taking charge. State experience, age and salary expected. "Capable," AMERICAN MACHINIST.

MICHIGAN

Wanted—Superintendent for factory making stamped and cast brass goods, most of which are nickel plated. Departments—pressroom brass foundry, monitor, polishing, plating, assembling, etc. Age between 30 and 45 years. Must be clean cut, forcible, energetic, good character and habits, a producer at a minimum cost, first-class executive. One who knows that there should be a place for everything and sees that everything is in its place. No red tape man but a systematic one. One who knows how to talk when necessary, but who talks little and does much, who makes occasional mistakes, but who usually finds mistakes and corrects them before they are made; who knows the meaning of the word "results" but not of "obstacles." Not a perfect man, nor one who knows it all, only one who knows how to hit straight from the shoulder and make every move count. Location, Michigan. If you can't qualify, do not answer. To be considered give age, experience and salary expected, references and any information that will aid in determining qualification. Permanent and growing position to right man. Address "Metal," AMERICAN MACHINIST.

NEW YORK

Wanted—Experienced designer of jigs and fixtures for the manufacture of small interchangeable parts. Box 102, AMER. MACHINIST.

Wanted—Sales manager for company manufacturing motor trucks of one, three and five tons capacity. Give full information relative to positions held, etc., in first letter. Box 96, AMERICAN MACHINIST.

First-class grinder, familiar with Landis and Norton machines. First-class machinist preferred. Address, with full particulars, to H. J. H., Box 100, AMERICAN MACHINIST.

A good machinist who can lay out and inspect work. Good position to right man. Address, with full particulars, H. J. H., Box 99, AMERICAN MACHINIST.

OHIO

Wanted—By large concern in Middle States four first-class lathe hands, men capable of handling from two to six men and boys and teaching them to do good and rapid lathe work. Applicants will have good opportunity to travel as lathe demonstrators. In writing give past five years' experience. Box 33, AM. MACH.

PENNSYLVANIA

Wanted—General superintendent for valve manufacturing plant, making iron and brass. State age, experience and salary expected. Box 94, AMERICAN MACHINIST.

Wanted—Foreman patternmaker for valve company. State age, experience, and salary. Box 93, AMERICAN MACHINIST.

For Sale

For Sale—Second-hand Hornsby Akroyd oil engines, one 13 horse-power and one 23 horse-power, in first-class shape. Balbach Smelting & Refining Co., Newark, N. J.

For Sale Cheap—Before removal, one 28"x26' Fitchburg engine lathe, compound rest, etc., two Pratt & Whitney screw machines, ¾ or ⅞ through spindle, and 7x36 and 9x36 precision bench lathes. J. Bleser, Springfield, Ill.

For Sale—Improved tool holder patent, just issued. A practical tool holder, superior to anything placed on the market, not a copy of some other make nor in the freak class; has been tested for two years. This is a live proposition and a money-maker for party having the equipment or capital to go into it. Don't write unless you have the cash and mean business. Box 92, AMERICAN MACHINIST.

Alphabetical Index to Advertisers

	PAGE
Abrasive Material Co.	146
Acme Machinery Co.	94
Adams Co.	104
Albro-Clem Elevator Co.	162
Almond Mfg. Co., T. R.	134
Alteneder & Son, Theo.	143
American Emery Wheel Wks.	146
American Gas Furnace Co.	122
American Pulley Co.	155
American School of Correspondence	115
American Tool and Mach. Co.	130
American Tool Works Co.,	8 and 170
American Tube & Stamping Co.	173
American Watch Tool Co.	127
American Wood Working Machinery Co.	87
Ames Co., B. C.	132
Armstrong Blum Mfg. Co.	132
Armstrong Bros. Tool Co.	97
Automatic Machine Co.	139
Baker Bros.	166
Baldons & Oliver	128
Barnes Co., W. F. & John	14
Barnett, G. & H.	42
Bath Grinder Co., Inc.	147
Baush Machine Tool Co.	3d cover
Bay State Stamping Co.	144
Beaman & Smith	15 and 134
Becker-Brainard Milling Machine Co.	32 and 33
Bemis & Call Hardware & Tool Co.	117
Berry & Parker	151
Bertsch & Co.	133
Besly & Co., Charles H.	95
Bethlehem Foundry and Machine Co.	131
Bickford Drill & Tool Co.	10
Bignall & Keeler Mfg. Co.	105
Bilgram, Hugo	165
Billings & Spencer Co.	142
Birdsboro Steel Foundry & Mach. Co.	101
Blaisdell Machinery Co.	79
Blanchard Machine Co.	114
Bliss Co., E. W.	25
Blount Co., J. G.	148
Boston Gear Works	162
Boston Saw and Tool Co.	165
Bowsher & Co., N. P.	144
Boynton & Plummer	120
Bradford Machine Tool Co.	5
Bradley & Son, C. C.	125
Bristol Co.	4th cover
Brown & Co., R. H.	135
Brown & Sharpe Mfg. Co.,	57 and 4th cover
Brown Hoisting Mchry. Co.	154
Brubaker & Bros., W. L.	132
Bullard Mach. Tool Co.	41
Burk Machinery Co.	77
Burke Electric Co.	159
Burr & Son, John T.	131
Bury Compressor Works	79
Byram & Co.	144
C & C Electric Co.	158
Caldwell & Son Co., H. W.	114
Cammel, Laird & Co.	151
Carborundum Co.	6
Card Mfg. Co., S. W.	23
Carpenter Tap & Die Co., J. M.	138
Carver File Co.	142
Case Mfg. Co.	154
Cell Drier Machine Co.	151
Chadwick & Trefethen	144
Chambersburg Engineering Co.	120
Champion Tool Works Co.	117
Chicago Flexible Shaft Co.	77
Chicago Machine Tool Co.,	92 and 107
Chicago Raw Hide Mfg. Co.	155
C. I. F. Co.	141
Cincinnati Chuck Co.	134
Cincinnati Elec. Tool Co.	159
Cincinnati Lathe & Tool Co.	131
Cincinnati Machine Tool Co.	24
Cincinnati Milling Mach. Co.	7
Cincinnati Planer Co.	36
Cincinnati Shaper Co.	171
Clark Cast Steel Cement Co.	151
Clark, Jr., Electric Co., Inc., James	159
Clayton Air Compressor Wks.	79
Cleveland Auto. Mach. Co.	18
Cleveland Cap Screw Co.	167
Cleveland Crane & Car Co.	155
Cleveland Planer Works	110
Cleveland Stone Co.	149
Cleveland Twist Drill Co.,	4th cover
Cling-Surface Co.	124
Colcord Machinery Co., W. R.	170
Clum & Atkinson	151
Coates Clipper Mfg. Co.	78
Cochrane-Bly Co.	102
Coes Wrench Co.	26 and 27
Colburn Machine Tool Co.	161
Colcord Machinery Co., W. R.	170
Cook Co., Asa S.	132
Consolidated Press and Tool Co.	109
Crescent Forgings Co.	166

PAGE

Crocker-Wheeler Co.....160
Crosby Steam Gage & Valve Co.....167
Cullman Wheel Co.....149
Curtis & Curtis Co.....132
Cushman Chuck Co.....137

Davis Machine Co., W. P....170
Desmond-Stephan Mfg. Co....88
Detrick & Harvey Mach. Co..132
Diamond Chain & Mfg. Co....99
Diamond Machine Co.....42
Diamond Saw and Stamping Works.....115
Dickinson, Thos. L.....42
Dill Slotter People.....131
Dixon Crucible Co., Jos.....101
Dreses Machine Tool Co.....9

Earle Gear & Mach. Co.....162
Eastern Machinery Co.....129
Eberhardt Bros. Mach. Co....165
Eck Dynamo & Motor Co....170
Elliott Chemical Works.....151
Elmes Engineering Works, Chas. F.....140
Errington, F. A.....135
Estep & Dolan.....144
Evans Friction Cone Co.....129
Excelsior Needle Co.....78

Farrel Fdry. & Machine Co..104
Fawcus Machine Co.....165
Fay Machine Tool Co.....119
Fellows Gear Shaper Co.....63
Felton, Sibley & Co.....129
Ferracute Machine Co.....117
Firth-Sterling Steel Co.....152
Fitchburg Machine Works....31
Flather Planer Co., Mark....99
Foote Bros. Gear & Mach. Co.165
Foote-Burt Co., The.....112
Fosdick Machine Tool Co....16
Franklin Mfg. Co., H. H.....151
Franklin Portable Crane & Hoist Co.....155
Fulton Machine & Vise Co...145

Gang Co., Wm. E.....144
Garden City Fan Co.....131
Gardner Machine Co.....149
Garvin Machine Co.....81
Gem Mfg. Co.....122
General Electric Co.....156
General Pneumatic Tool Co..155
Geometric Tool Co.....25
Gisholt Machine Co.....173
Gleason Works.....4th cover
Globe Mach. & Stamping Co..128
Goldschmidt Thermit Co.....152
Gorton Machine Co., Geo....138
Gould & Eberhardt.....73
Graham Mfg. Co.....145
Grant Gear Wks.....162
Grant Mfg. & Mach. Co.....123
Gray Co., G. A.....28
Greaves, Klusman & Co.....129

Hammacher, Schlemmer Co.. 67
Hardinge Bros.....108
Harrison & Knight Mfg. Co..141
Harrington, Son & Co., Edw.118
Hart & Cooley Co.....123
Hart Mfg. Co.....125
Hendey Machine Co.....65
Henry & Wright Mfg. Co....105
High Duty Saw and Tool Co. 71
Hill, Clarke & Co., Inc.....169
Hill Publishing Co...83 and 170
Hisey-Wolf Machine Co.....102
Hoefer Mfg. Co.....77
Hoggson & Pettis Mfg. Co...134
Horsburgh & Scott Co.....164
Horton & Son Co., E.....134
Howson & Howson.....144
Hunt Co., Robt. W.....132
Hurlbut-Rogers Machine Co..126

PAGE

Independent Pneumatic Tool Co.....79
Industrial Oxygen Co.....150
Ingersoll Milling Machine Co. 76
International Correspondence Schools.....82

Jacobs Mfg. Co.....135
Jantz & Leist Elec. Co.....160
Johnson Machine Co., Carlyle 65
Jones & Lamson Mach. Co., 12, 13 and 42
Juengst & Sons, George.....141

Kearney & Trecker Co.....84
Kelly Co., R. A.....133
Kempsmith Mfg. Co.....22
Kern Machine Tool Co.....114
Keuffel & Esser Co.....143
Knight Mchry. Co., W. B....149
Kolesch & Co.....142
Krieger Tool & Mfg. Co.....131
Krupp (Prosser & Son, Thos).150

L. & D. Co.....133
Lamson Consol. S. S. Co....155
Landis Machine Co.....128
Landis Tool Co.....59
Lang & Co., G. R.....130
Lapointe Machine Tool Co...103
Lea Equipment Co.....140
LeBlond Machine Tool Co., R. K....67, 71 and 4th cover
Leonard Mfg. Co.....165
Link Belt Co.....85
Lodge & Shipley Machine Tool Co.....4
Long & Allstatter Co.....124
Lucas Machine Tool Co.....172
Lufkin Rule Co.....142
Lumen Bearing Co.....150
Lunkenheimer Co.....122
Lyon Metallic Mfg. Co.....133

Macdonald & Macdonald.....144
Machine Screw Products Co..142
Manning, Maxwell & Moore, Inc.....154
Manufacturing Equipment and Engineering Co.....123
Manville Bros. Co.....173
Manville Machine Co., E. J.. 77
Maris Bros.....154
Marshall & Huschart Mch. Co.168
Marston & Co., J. M.....165
Massachusetts Saw Works..140
McCabe, J. J.....35 and 168
McInnes Steel Co.....153
Mechanics Machine Co.....130
Merrell Mfg. Co.....130
Merritt, Jos.....132
Merritt & Co.....132
Metal Hardening Solution Co.150
Millers Falls Co.....130
Milton Mfg. Co.....116
Miner & Peck Mfg. Co.....129
Mitts & Merrill.....161
Moline Tool Co.....133
Monarch Emery & Cor. Wheel Co.....146
Moore Co., Franklin.....154
Morris Foundry Co., John B.112
Morse Chain Co.....100
Morse Twist Drill & Mach. Co. 61
Morse, Williams & Co.....165
Morton Mfg. Co.....113
Mossberg Wrench Co.....128
Motch & Merryweather Machine Co.....170
Mueller Mach. Tool Co.....129
Mumford Co., E. H.....124
Munmert, Wolf & Dixon Co..124
Mutual Machine Co.....132

Nash & Co., Geo.....153
National Acme Mfg. Co.....174
National Machine Co.....131

PAGE

National Machinery Co.....108
National Machine and Tool Co.....132
New Britain Mach. Co.....123
New Haven Mfg. Co.....110
New Process Raw Hide Co...163
Newton Machine Tool Works, Inc.....11
Nicholls, Wm. S.....155
Nicholson & Co., W. H.....119
Nicholson File Co.....17
Niles-Bement-Pond Co., 37, 38, 39, 40 and 169
Northern Electrical Mfg. Co.157
Northern Engineering Works.154
Norton Co.....75
Norton Grinding Co.....74
Nuttall Co., R. D.....164

Obermayer Co.....153
O. K. Tool Holder Co.....132
Oesterlein Machine Co.....115
Owen Machine Tool Co.....22

Parker, C. L.....144
Parker Company, Chas.....145
Pawling & Harnischfeger....154
Paxson Co., J. W.....128
Philadelphia Bourse.....106
Philadelphia Gear Works, 161 and 162
Pittsburg Auto. Vise & Tool Co., Ltd.....145
Pittsburg Emery Wheel Co..140
Plunket, J. E.....144
Potter & Johnston Mach. Co., 20 and 21
Powell & Co., Wm.....144
Powell Tool Co.....135
Pratt Chuck Co.....136
Pratt & Whitney Co....2 and 3
Prentice Bros. Co.....1 and 29
Prentiss Tool & Supply Co., 166 and 168
Prentiss Vise Co.....144
Prosser & Son, Thos.....150

Q. C. Machine Tool Co.....116

Reed Co., F. E.....93
Reed Mfg. Co.....145
Reichhelm & Co., E. P.....133
Remington Tool and Machine Co.....117
Ridgway Dynamo & Engine Co.....159
Risdon Tool Works.....165
Rivett Lathe Mfg. Co....3d cover
Robbins Machine Co.....128
Robinson Tool Works.....166
Rockford Drilling Machine Co.111
Rock Island Tool Co.....145
Rockwood Mfg. Co.....154
Rogers & Hubbard Co.....150
Rogers Wks., John M.....82
Root Co., C. J.....132
Roth Bros. & Co.....159
Royersford Fdry. & Mach. Co.149

Safety Emery Wheel Co.....147
Sames, C. M.....128
Saunders Sons, D.....133
Sawyer Gear Wks.....162
Sawyer Tool & Mfg. Co.....144
Schellenbach-Hunt Tool Co..142
Schieren Co., Chas. A.....89
Schmitz, August.....130
Schuchardt & Schutte.....73
Schumacher & Boye.....9
Schwerdtle Stamp Co.....132
Sebastian Lathe Co.....24
Sellers & Co., Inc., Wm.....30
Seneca Falls Mfg. Co., 106 and 170
Shultz Belting Co.....160
Sibley Mch. Tool Co.....121
Simonds Mfg. Co.....107
Skinner Chuck Co.....134

PAGE

Slate Machine Co., Dwight...130
Sloan & Chace Mfg. Co., Ltd.139
Slocomb Co., J. T.....90
Smith, Chas. F.....132
Smith Countershaft Co.....31
Smith & Mills.....144
Smith Co., Wm. J.....91
Spacke Mach. Co., F. W.....79
Springfield Mach. Tool Co....15
Standard Connecting Rod Co.125
Standard Engineering Works.142
Standard Gauge Steel Co....167
Standard Tool Co.....98
Standard Welding Co.....126
Stark Tool Co.....129
Starrett Co., L. S.....96
Steptoe Shaper Co., John....144
Stevens, Frederick S.....150
Stoever Fdry. & Mfg. Co....140
Stow Mfg. Co.....158
Sturtevant Co., B. F.....34
Swaine Mfg. Co., Fred J.....167

Tabor Mfg. Co.....116
Taylor & Fenn Co.....121
Taylor-Wilson Mfg. Co.....162
Technical Supply Co.....143
Tindel-Morris Co.....109
Toledo Machine & Tool Co...114
Toomey, Frank.....170
Triumph Electric Co.....158
Tudor Mfg. Co.....86
Turner Brass Works.....155
Turner Machine Co.....131

Underwood & Co., H. B.....137
Union Mfg. Co.....135
Union Twist Drill Co.....69
Universal Drafting Mach. Co.143
Universal Machine Screw Co.141
U. S. Electrical Tool Co.....80

Van Dorn & Dutton Co.....164
Van Dorn Elec. & Mfg. Co..158
Vandyck Churchill Co.....125
Veeder Mfg. Co.....143
Vitrified Wheel Co.....148
Von Wyck Mach. Tool Co....113

Wagner Electric Mfg. Co....160
Walcott & Wood Mach. Tool Co.....127
Walker & Pratt Mfg. Co....151
Wallace Supply Co.....165
Waltham Machine Works....128
Waltham Watch Tool Co....74
Ward & Sons, Edgar T.....150
Warner & Swasey Co.....172
Warner Instrument Co.....129
Waterbury Farrel Fdry. & Mach. Co.....174
Watson-Stillman Co.....118
Wellman Co.....144
Western Electric Co.....157
Western Tool and Mfg. Co...116
West Haven Mfg. Co.....115
Westinghouse Elec. & Mfg. Co.157
Westmacott Gas Furnace Co.165
Whitcomb - Blaisdell Machine Tool Co.....19
Whitman & Barnes Mfg. Co..111
Whitney Mfg. Co.....33
Whiton Machine Co., D. E...136
Wiley & Russell Mfg. Co....103
Williams & Co., J. H.....142
Williams Foundry and Machine Co.....122
Williamson Vise Co.....145
Wilmarth & Morman Co.....146
Winkley Co.....133
Woodward & Powell Planer Co.....76
Worcester Machine Screw Co.132
Wormer Machinery Co., C. C.170
Wrigley Co., Thos.....146
Wyke & Co., J.....165

Yale & Towne Mfg. Co.....79

Classified Index to Articles Advertised

Abrasive Materials

Abrasive Material Co., Phila., Pa.
American Emery Wheel Co., Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Dickinson, Thos. L., New York.
Monarch Emery & Cor. Wheel Co., Camden, N. J.
Norton Co., Worcester, Mass.
Pittsburg Emery Wheel Co., Pittsburg, Pa.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.

Agents, Foreign Machinery

Churchill & Co., Chas., London, Eng.
C. I. F. Co., New York.

Air Lifts

Ingersoll-Rand Co., New York.

Alundum

See Grinding Wheels.

Arbor Presses

Barnes Co., W. F. & John, Rockford, Ill.
Marshall & Huschart Machinery Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Arbors

Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Union Twist Drill Co., Athol, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Arbors, Expanding

Cochrane-Bly Co., Rochester, N. Y

Balancing Ways

Bowsher Co., N. P., South Bend, Ind.

Barrels, Steel

Lyon Metallic Mfg. Co., Aurora, Ill.

Barrels, Tumbling

Globe Machine & Stamping Co., Cleveland, O.

Bars, Boring

Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
Elmes Engineering Works, Chas. F., Chicago, Ill.
Krieger Tool & Mfg. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Bars, Boring —*Continued.*

Underwood & Co., H. B., Philadelphia, Pa.

Bearings, Ball and Roller

Boston Gear Works, Norfolk Downs, Mass.
Hyatt Roller Bearing Co., Harrison, N. J.

Belt Dressing

Cling-Surface Mfg. Co., Buffalo, N. Y.
Desmond-Stephan Mfg. Co., Urbana, Ohio.
Dixon Crucible Co., Joseph, Jersey City, N. J.
Schieren Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Fasteners

Bristol Co., Waterbury, Conn